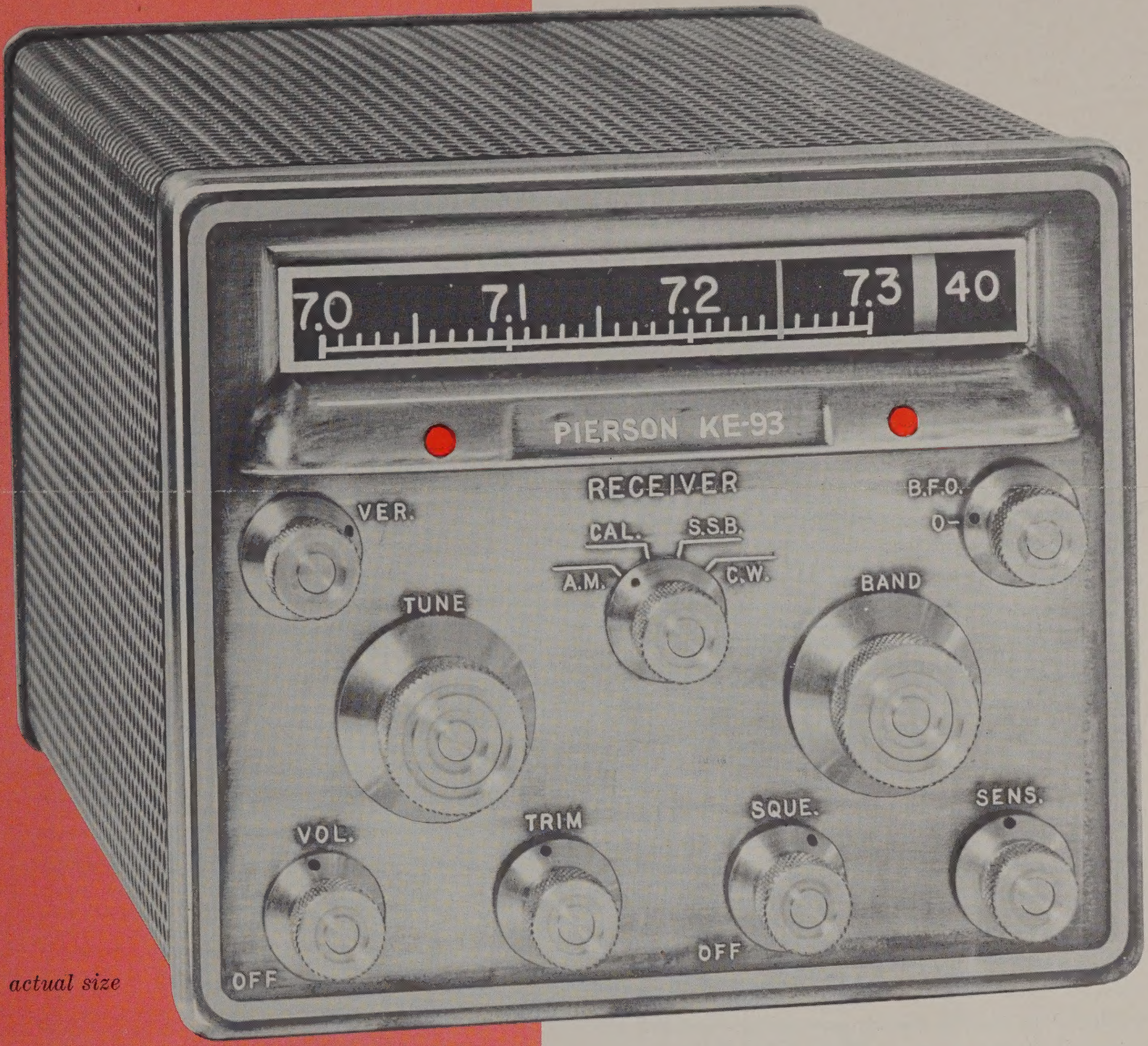


actual size

PIERSON KE-93

for the first time!

a full-fledged 12-tube all-band communications receiver in a small, mobile package

PRECISION MOBILE OR FIXED STATION COMMUNICATIONS RECEIVER

field performance comparable to large table models

in motion or on the table top, the tiny

PIERSON KE-93

DUAL-CONVERSION SUPERHETERODYNE

makes tough contacts easily and holds 'em longer

Despite its extraordinary compactness, the KE-93 is a full-fledged communications receiver. It delivers high over-all performance on seven bands: 10, 15, 20, 40, 80 and 160 meters, and broadcast band. It pulls in weak stations and holds them long after other receivers have lost them. Excellent mechanical design and rigid construction provide jitter-free operation under vibration. The KE-93 is not to be confused with equipment sold for mobile use only.

Military Developments Lead to Small Size – Without Compromise

The KE-93 makes no sacrifice in performance to save space. Its compactness is an *additional* advantage made possible by new miniaturization technics, materials and components initially developed to meet military requirements. For example, minute inductors of extremely high Q are used throughout the circuitry, effecting space savings heretofore undreamed of. The same is true of other KE-93 components.

While built to outperform existing mobile receivers, the KE-93 also equals or surpasses many receivers of the large, table-top variety.

New Noise Suppression Circuitry Employed, Over-All and Inter-Channel

Pierson receivers have for years been famous for the effectiveness of their noise-elimination circuits. The KE-93's advanced circuitry reflects the findings of more than 25 years of Pierson research. It offers exceptional freedom from noise under all conditions of mobile use.

The squelch circuit is highly sensitive and may be adjusted by its front panel control to open on A. M. signals too weak to be readable. The result is quiet operation between stations, without the danger of passing up weak signals.

Rigid, Die-Cast Construction Helps KE-93 Take "In-Motion" Knocks

The wide use of die-cast construction in the KE-93 assures an extremely rugged over-all package. Much of the dial, assembly is cast as an integral part of the front panel, affording accurate assembly and permanence of adjustment. The entire front panel assembly is plated and satin finished, providing a durable, corrosion-resistant finish and strong highlighting of lettering for day and night legibility. The case is heavy perforated steel in Hammertone silver grey finish.

Karl E. Pierson W6BGH
***Chief Engineer,* Automation Electronics, Inc.**

Karl is the designer of many other famous receivers, such as the PR-15, PR-16, and KP-81. He has been an avid amateur radio fan since 1921, and has been active in the design of receivers for over 25 years. During these years, he has been the recipient of many Public Service and other outstanding awards in recognition of his contributions to amateur radio.

• *Recent Equipment—*

The Pierson KE-93 Receiver

THERE are some receivers on the market these days that a patient ham could come close to duplicating in a home workshop without too many special tools, but the KE-93 isn't one of them. This "little" receiver is little only in physical size; in many other respects it is a "big" receiver. For example, it is the only U. S. communications receiver in many years that uses a turret assembly to house the r.f., mixer and oscillator coils. Anyone who has ever thought about designing a receiver is probably familiar with the circuit advantages (short leads, positive reset) that are obtained with a turret, but the evidence is that manufacturers don't like to fuss with them. The KE-93 uses an i.f. noise silencer that works equally well with the b.f.o. on or off, and squelch operation is available for those who recognize its usefulness.

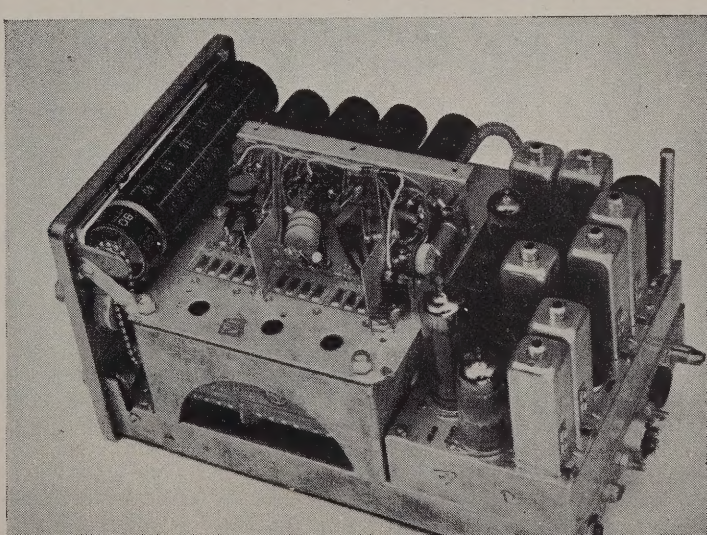
To fill you in at the start, just in case you haven't been reading the ads for this new receiver, it is a double-conversion receiver that tunes the broadcast band and the ham bands 160 through 10 meters (excluding 11). A slide-rule dial is used, and only the band in use is displayed. You can switch from 10 meters to the broadcast band in a single step; it isn't necessary to back up around the band switch. The KE-93 is intended for use in the car or in the home, and two different power supplies are available. One power supply uses 115-volt a.c. input; this supply includes a built-in loudspeaker and an S meter. The supply for mobile work can handle either 6.3- or 12.6-volt batteries; it includes a speaker but no S meter. (Any driver who misses the S meter in a mobile rig should have a heart-to-heart talk with his local committee on highway safety.) No changes are required in the receiver when using one or the other of the supplies; it is merely a matter of unplugging the connectors from one supply and plugging in those from the other.

Electrically the front end of the KE-93 is fairly conventional, as can be surmised from the block diagram in Fig. 1. A 6BZ6 is used in the r.f. stage; one point of departure is that the input circuits are designed for a 50-ohm impedance level rather than the usual "300 ohms" compromise level found in quite a few receivers. The thinking at this point is that since the transmitter probably wants a load of around 50 ohms, the antenna will be adjusted to look like 50 ohms, so why not give the receiver a break? Single exception is the high-impedance input on the broadcast band, and that is logical enough until we are allowed to transmit in that band.

A 6BE6 mixer is driven by a 3CB6 oscillator. The oscillator tube, if you aren't familiar with that type number, is merely a 3.15-volt-heater version of the 6CB6. Using the lower-voltage heater allows the use of a 7HTF ballast tube in series with the heater, and wide variations in heater supply voltage should have little effect on the cathode (and tube) temperature. From the 6BE6 mixer the signal passes through two tuned circuits at 2.2 Mc. to a crystal-controlled 6BE6 converter and from there to the 265-kc. second i.f. The second i.f. doesn't skimp on tuned circuits; there are four between the 6BE6 and the 6BA6 i.f. stage, three between 6BA6 and the 6BE6 i.f. amplifier (more about this stage later) and two between the 6BE6 and the 6AL5 detector. The selectivity of 3 kc. with a shape factor of 2.3 (3.0 kc. at −6 db., 6.9 kc. at −60 db.) is just about right for phone reception and is even good enough for single-signal c.w. reception (our pet qualitative test).

From the detector a 12AX7 builds up the audio to kick a 6AQ5 output stage. The other 12AX7 triode is used as the b.f.o., but this b.f.o.

The KE-93 receiver packs a lot of equipment in a small space. For this view a cover has been removed to show the turret contacts and the interstage shielding for the receiver "front end" (horizontally-mounted tubes). Blackened tube shields are used to disperse the heat more rapidly and thus reduce the temperature rise.



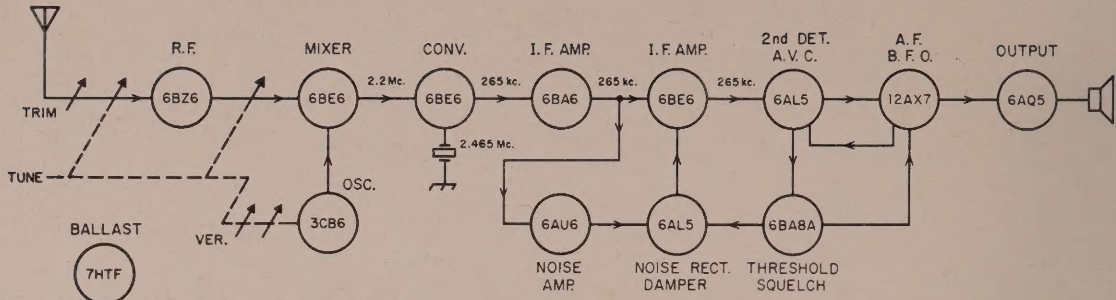


Fig. 1—Block diagram of the KE-93 receiver. This double-conversion receiver is intended for either home or mobile use. Power supplies are separate.

has a couple of variations from the norm. The panel control for the b.f.o. frequency is a variable *resistor!* The *LC* circuit of the grounded-plate b.f.o. uses across the inductance a 330-$\mu\mu$f. capacitor in series with a 0.002 μf. to ground. The 500-ohm variable resistor b.f.o. control has one side grounded and the other side goes through a 0.005-μf. capacitor to the junction of the 330-$\mu\mu$f. and 0.002-μf. capacitors. When the resistance is minimum the two large capacitors are in parallel; increasing the resistance tends to remove the 0.005-μf. capacitor from the circuit. The other variation is that when a function switch is thrown from s.s.b. to c.w. the b.f.o. voltage is reduced. This may be for c.w. limiting action.

The noise silencer circuit is similar to the Lamb silencer of the middle 1930s but with several important variations. (The Lamb is James J., then the technical editor of *QST*). The original circuit used substantially the same tube configuration as shown in Fig. 2. A sample of the signals in the i.f. strip is tapped off, amplified in a noise (and signal) amplifier and rectified in a noise rectifier. In the original circuit a manual control of bias on the noise amplifier was provided, and it was set so that an incoming signal wasn't rectified but the "spikes" of loud noise riding above the signal were. These rectified noise spikes, or pulses, were then used in the i.f. amplifier to cut off an amplifier tube during the existence of the pulse.

The KE-93 circuit uses several modifications that improve the operation or make it more automatic. Referring to Fig. 2, it can be seen that the bias on the silencer is not set manually but is determined automatically by the level

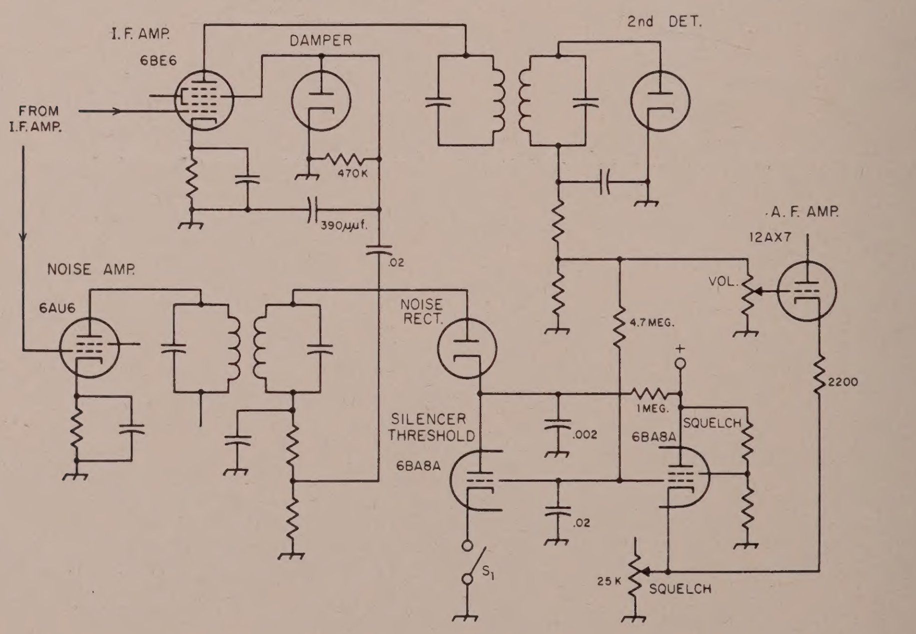
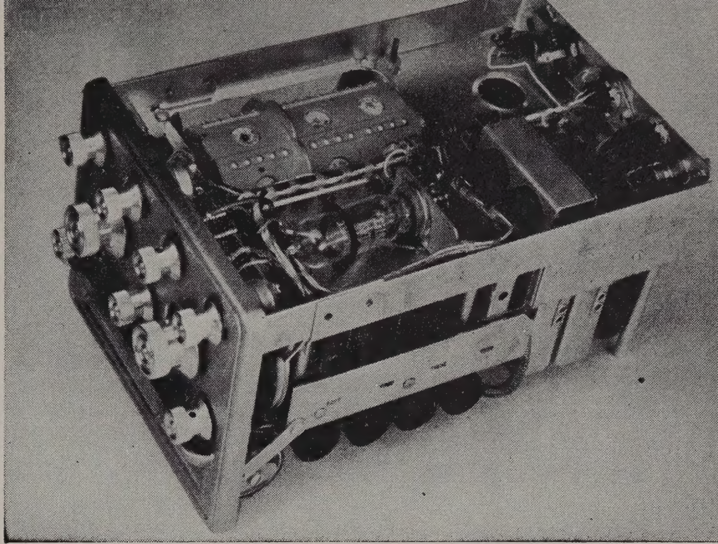


Fig. 2—Circuit details of the noise silencer and squelch. Noise-silencer circuit is a modification of the Lamb circuit using a.c. coupling, automatic threshold set and a damper tube.

The use of sub-assemblies reduces the wiring under the chassis, and the most prominent feature here is the ballast tube used in series with the oscillator heater. Speaker and headphone connections are at the rear of the receiver.



of an incoming signal. The bias is obtained from the drop across the triode section of the 6BA8A; this drop increases as the level of an incoming signal increases. In the original Lamb circuit, d.c. coupling was used between the noise rectifier and the controlled i.f. amplifier (6BE6 in Fig. 2), and this permitted strong adjacent-channel carriers to "lock up" the i.f. The KE-93 uses a.c. coupling (the 0.02-μf. capacitor) and permits only pulses to be transmitted to the grid of the i.f. stage. To avoid driving the grid of the 6BE6 positive at any time, a 6AL5 diode is used as a damper. The big advantage of an i.f. silencer like this is that it has no apparent effect on the quality of the observed signal; switching it in merely makes the ignition noise disappear.

As indicated in Fig. 1, squelch is incorporated in the KE-93, and a portion of Fig. 2 shows how it is obtained. The cathode bias of the 12AX7 audio amplifier is determined by the plate current and the total resistance in its cathode circuit, just as long as there is enough signal coming in to bias the 6BA8A squelch tetrode to cut off. When the incoming signal is removed, the squelch tube draws current which can develop a sizable voltage across the portion of the 25K squelch control if the arm is up high enough. This voltage can be enough to cut off the 12AX7 and silence the receiver. In operation the squelch action is quite smooth. The switch S_1, which turns the i.f. silencer on or off, is part of the squelch potentiometer assembly, so that the silencer is on any time the squelch is being used, but the silencer can be turned on without making the squelch operative, merely by turning the control just far enough to flick on the switch.

The use of the i.f. silencer improves the performance of the squelch. The usual squelch circuits will open on noise, and this fact limits the threshold at which they can be set without opening on noise. Silencing in the i.f. makes the squelch considerably less vulnerable to noise.

The a.c. power supply has the S meter on the front panel, and the S-meter circuit uses a 6BJ6 to meter the a.v.c. bus and furnish a variable voltage for the S meter. This power supply also has a switch on it to cut the B+ without turning off the heater voltages, a "communication switch."

Rounding out the circuit details, manual gain is applied to the r.f. stage and the first i.f. amplifier, and the a.v.c. controls the r.f. stage, the converter stage and the two i.f. stages. The a.v.c. is switched out when the b.f.o. is on.

Mechanical Features

The turret assembly housing the front-end inductors has already been mentioned briefly. Mica-filled phenolic parts are used for the strips, and the sections adjacent to the active one are always shorted out through additional contacts. On the broadcast and 160-meter bands single conversion is used, and on these bands a cam on the turret assembly actuates a pair of switches to jump the converter stage. A chain drive between the turret shaft and the slide-rule dial changes the scale as the band is changed. One local wit observed that this was the first receiver he had seen that could be repaired with a key chain, but he normally takes a negative attitude and doesn't appreciate the positive action the chain gives. The detents on the turret are smooth and definite.

Another mechanical feature is the die-cast panel, with all the labels in bas-relief. A nice stunt is the overhang just under the dial scale; it reflects light down on the controls without taking away from the illumination of the dial scale. The tuning capacitor and dial pointer are string driven; 7½ turns of the tuning knob carries you across any band. While this tuning rate is slow enough to permit direct tuning of side-band signals on some of the smaller bands, it becomes a bit tricky on 10 meters. This is no great detriment, however, because when you do run across a side-band signal there (and you want to tune it in), it is an easy matter to do the tuning with the vernier tuning control, a small

trimmer across the oscillator section that serves as a vernier tune control or a calibration reset.

A four-position panel switch is marked A.M., CAL, S.S.B. and C.W. The CAL position permits setting your transmitter on frequency; in this position the b.f.o. and a.v.c. are on. The squelch circuit is operative only in the A.M. position.

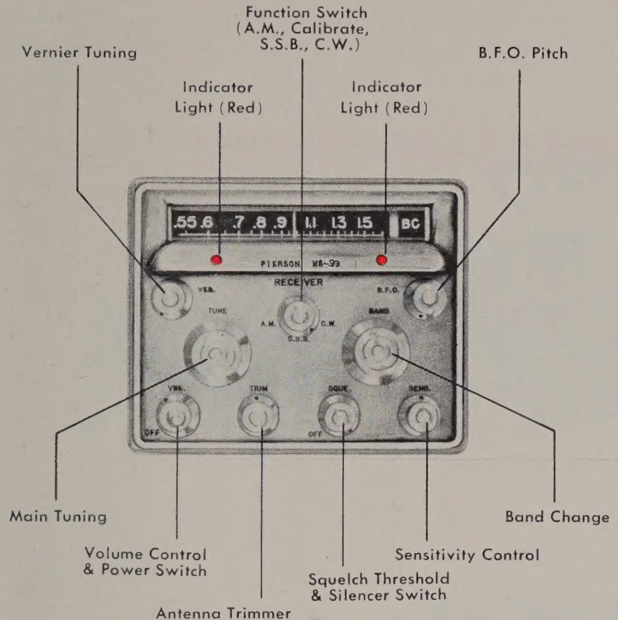
If you want to see a lot of circuits well laid out in a package only 5 inches high, 6 inches wide and 9 inches deep, take a look at the accompanying photographs of their receiver.

The Pierson KE-93 is manufactured by Automation Electronics, Inc., Burbank, Calif.

— *B. G.*

Reprinted from May 1958 *QST*

KE-93 DIMENSIONS: 5″ HIGH, 6″ WIDE, 9″ DEEP



New, Functional Design Simplifies Control Operation

Reversing the normal order of controls and positioning the dial high on the panel simplifies "in-motion" operation of the KE-93. When the set is mounted under the dash, those controls used most are nearest the operator. When the receiver is mounted on the steering column, the operator's hand does not obscure the dial while manipulating controls. The dial displays only the band in use. Indirect illumination of the entire panel is provided for night reading.

The power control actuates the power switch for either A. C. or mobile operation. Proper impedance matching to a wide variety of antennas is assured by the antenna trimmer. Regardless of function switch setting, the sensitivity control is in operation at all times. The squelch threshold control also actuates the silencer switch, although silencer switch-out is not necesary for any type of operation.

For S. S. B. and C. W. operation, the B. F. O. pitch control affords a swing of plus or minus 3 K. C. The tuning vernier control effects an average of a few hundred cycles plus or minus swing for precision S. S. B. tuning. The function switch automatically sets up control of A. G. C. and B. F. O. for receiving various types of signals (A. M., C. W., and S. S. B.) S. S. B. position provides exalted B. F. O., while the calibrate position permits use of B. F. O. and A. G. C. simultaneously for transmitter V. F. O. spotting.

Handsome in appearance, the die-cast control panel has a satin finish. Knobs are of turned duraluminum and the dial scale is electro-etched metal with large silver letters against a dull black background.

R. F. Section Offers High-Frequency Efficiency, Jitter-Free Reception

Excellent S. S. B. and other types of reception are possible under "in-motion" conditions because of the sturdiness of the R. F. assembly. The tuning portion (front end) of the KE-93 is the revolving turret type. Mica-filled alkyd molded parts which include contact strips, coil mountings, trimmer housings, etc., provide maximum insulation qualities. The turret drum is housed in a rigid, die-cast frame and revolves on ball bearings. Thrust is adjustable to compensate for any possible play created by wear. Most of the R .F. components are silver plated for maximum high-frequency efficiency.

Dual Conversion Circuitry is Free from Image and Spurious Responses

Dual conversion in the KE-93 employs a first I. F. of 2.2 M. C. and a second I. F. of 265 K. C. Image and spurious responses are virtually non-existent, being 80 DB down.

Quadruple-Tuned I. F. Networks Offer 3 K. C. Selectivity

The sensitivity is well under 1 microvolt (3 DB plus noise to noise) on all bands with the exception of broadcast, where a sensitivity of 5 microvolts is purposely employed.

The selectivity provides a 3 K. C. bandwidth, flat-topped with a shape factor of better than 2.3. This is accomplished through the use of very high Q quadruple-tuned I. F. networks. The signal must pass through 12 tuned circuits on 160 meters and broadcast, and 14 tuned circuits on all higher frequency bands. The resultant skirt rejectivity and signal separation are of an order not previously experienced by most operators.

GENERAL CIRCUITRY

The KE-93 circuitry consists of one stage of R. F., first mixer, local oscillator, second mixer and crystal oscillator, 2.2 M. C. intermediate frequency, 2 stages quadruple-tuned 265 K. C. intermediate frequency, second detector, separate A. G. C. detector, two stages audio including output, beat frequency oscillator and a full complement of noise elimination and squelch circuitry involving four tubes, some dual.

ACCESSORIES

Communications circuitry is provided in the power pack for "break-in" (push-to-talk) operation.

Universal mounting brackets for mobile mounting are included with the receiver.

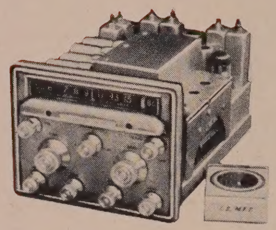
An "S" meter in an attractive mounting case with indirect illumination can be supplied at slight additional cost. The unit comes complete with cable attached, and plugs right into the socket provided on the back of the receiver.

SPECIAL MODELS

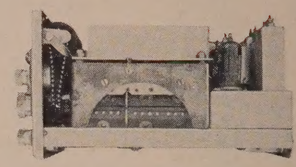
The KE-93, which is most in demand, is strictly an amateur band and broadcast coverage model. However, the extreme flexibility of the KE-93 design permits almost any conceivable combination of band coverage arrangements to as high as 300 M. C., fixed crystal control, turntable or a mixture of both.

The most common variation from the amateur version is a continuous coverage model tuning from above 40 M. C. through the broadcast band. This model has an additional band spread dial arrangement.

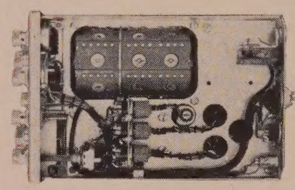
Other variations including two and six meter bands, and other special models and combinations can be furnished at slight extra charge.



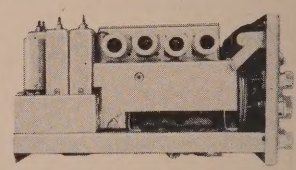
front view, grille off



revolving turret



bottom view



side view

Pierson products enjoy a 25-year reputation for excellence. They are familiar to veteran hams in such outstanding receivers as the PR-15, PR-16, KP-81 and others.

AUTOMATION ELECTRONICS, INC.

1500 WEST VERDUGO AVENUE, BURBANK, CALIFORNIA

KE-93 8-27 Printed in U.S.A

OPERATION AND MAINTENANCE MANUAL

PIERSON

KE-93

PRECISION MOBILE OR FIXED STATION COMMUNICATIONS RECEIVER

AUTOMATION ELECTRONICS, INC.

1500 WEST VERDUGO AVENUE, BURBANK, CALIFORNIA

OPERATION AND MAINTENANCE MANUAL

PIERSON

KE-93

PRECISION MOBILE OR FIXED STATION COMMUNICATIONS RECEIVER

AUTOMATION ELECTRONICS, INC.

1500 WEST VERDUGO AVENUE, BURBANK, CALIFORNIA

Figure 1. The KE-93 Receiver and A.C. Power Pack for fixed station operation

PIERSON KE-93 RECEIVER
OPERATION AND MAINTENANCE MANUAL

SECTION 1. INTRODUCTION

Your KE-93 Receiver is a precision instrument, built like a fine watch, treat it as such and it will serve you well.

The KE-93 Receiver is only 5⅛ inches high, 6⅛ inches wide, and 9 inches deep and weighs only 10½ pounds, net; yet, you may expect from it performance comparable to the finest large communication receivers. The KE-93 Receiver is intended for fixed station or mobile operation. A.C. and D.C. power packs that are normally supplied with the Receiver deliver 225 volts D.C. at 85 milliamperes, ± 5 percent. Voltages other than specified may cause damage or poor performance.

The Vipac (D.C. power supply) is 5⅛ inches high, 6⅛ inches wide, and 5⅛ inches deep and weighs 7¾ pounds, net. The Vipac operates on either 6 or 12 volts D.C. and draws 8 amperes from a 6 volt or 4 amperes from a 12 volt battery. The A.C. Power Pack, for use in a fixed station, is a unit that combines a power supply, speaker, and "S" meter in a package that is the same size as your Receiver except it weighs 11 pounds, net. Necessary interconnecting cables are supplied with each power pack.

Seven (7) separate frequency bands are covered by the Receiver as follows:

Band No.	*Band*	*Frequency*	*Color Code*
1	Broadcast	550-1650 kc	Brown
2	160 Meters	1650-3500 kc	Red
3	75 or 80 Meters	3500-4030 kc	Orange
4	40 Meters	6990-7310 kc	Yellow
5	20 Meters	13970-14360 kc	Green
6	15 Meters	20990-21450 kc	Blue
7	10 Meters	27950-30000 kc	Violet

Reversing the normal order of controls and positioning the dial high on the panel simplifies "in-motion" operation of the KE-93. When the set is mounted under the dash, those controls used most are nearest you. When the Receiver is mounted on the steering column, your hand does not obscure the dial while manipulating controls. The dial displays only the band in use. Indirect illumination of the entire panel is provided for night reading.

Power is switched on by turning the volume control when operating from a fixed station or from a car.

Proper impedance matching to a wide variety of antennas is assured by an antenna trimmer control.

For SSB and CW operation, the BFO pitch control affords a frequency swing of plus or minus 3 kc. The vernier tuning control varies the Receiver by only a few hundred cycles for precision SSB tuning.

Excellent SSB and other types of reception are possible under "in-motion" conditions because of Receiver stability due to the sturdiness of the RF assembly. The tuning portion (front end) of the KE-93 is a revolving turret. Moulded parts of mica-filled alkyd include contact strips, coil mountings, and trimmer housings providing maximum insulation qualities. The turret drum is housed in a rigid, die-cast frame and revolves on ball bearings. Thrust is adjustable, compensating for any possible play created by wear. Most of the RF components are silver plated for maximum high-frequency efficiency.

Dual conversion in the KE-93 employs a first IF of 2.2 mc and a second IF of 265 kc. Image and spurious responses are negligible — down 80 db or better.

Sensitivity is well under 1 microvolt (3 db plus noise-to-noise) on all bands with the exception of broadcast, where a sensitivity of 5 microvolts is purposely employed.

The selectivity provides a 3 kc bandwidth, flat-topped with a shape factor of better than 2.3. (The term shape factor is a definition of receiver selectivity, created because of the prevalence of high-powered signals in crowded bands which make the usual 3 db bandwidth measurements meaningless. The shape factor is the ratio between the bandwitdth measured at a point 6 db down on the response curve slope as compared to the bandwidth measured at a point 60 db down.) This excellent shape factor, in the KE-93, is achieved through the use of very high Q, quadruple-tuned IF networks. The signal must pass through 14 of these tuned networks on the high frequency bands or 12 networks on 160 Meters and Broadcast. The resultant skirt rejectivity and signal separation are of an order not previously experienced by most operators.

SECTION 2. OPERATION

Operation of the KE-93 Receiver conforms to standard practices. Special knowledge is not required. The following operating instructions are provided so you may obtain maximum performance from the Receiver.

Front Panel Controls

Front panel controls (see figure 1) are clearly identified and the following explanation is given to familiarize the operator with operating requirements characteristic of the KE-93 Receiver.

VER. Control. The vernier tuning control changes the dialed frequency by only a few hundred cycles. The VER. control permits very fine tuning, and is primarily useful for SSB and CW reception. When not in use, the red dot on the control should point horizontally toward the B.F.O. knob. Readjust the control to this position before tuning to another station.

B.F.O. Control. The B.F.O. control changes the pitch (frequency) of the beat frequency oscillator. The oscillator is switched in and out of the receiver circuitry by the function switch action.

RECEIVER Function Switch. The function switch has four positions: A.M., CAL., S.S.B., and C.W. Selection of a particular position changes the Receiver as follows:

A.M. Position. This position sets the Receiver for standard AM (amplitude modulated) reception, used in broadcast and amateur stations, and employs automatic gain control. All the controls on the panel are active except the B.F.O., which is not used in AM reception.

CAL. Position. This position is primarily used to set the transmitter VFO to the same frequency as the incoming signal. The CAL. position can also be used to calibrate the dial of the Receiver to an external RF oscillator. All of the controls on the panel are active (including B.F.O.) except the SQUE. (squelch and silencer) control, which is disabled. The RF strength of the incoming signal may require the operator to reduce sensitivity, by turning the SENS. control counterclockwise, to obtain a beat note that is tunable. The red dot on the B.F.O. knob is set to O-line position for best results.

S.S.B. Position. The single sideband position (S.S.B) of the function switch disconnects the automatic gain control, and connects the BFO into the Receiver in a high output condition. To properly receive SSB, it is necessary to turn the SENS. (sensitivity) control all the way off (extreme counterclockwise) and turn the VOL. (volume) control all the way on (extreme clockwise). Leave the VOL. control in this position. The B.F.O. control to be set approximately 15 to 20 degrees above or below the O-line on the panel. Changing the B.F.O. control from above to below the O-line changes the sideband. Next, advance the SENS. (sensitivity) control clockwise until the desired signal level is reached or until background noise is heard, if searching for SSB stations. The SENS. control functions as the only volume control when receiving SSB signals. The SSB station is tuned first with the main TUNE knob. Final vernier tuning is made with the VER. control. If the SSB signal is not intelligible, the B.F.O. control is on the wrong side of the O-line or not properly adjusted. It is suggested that the operator practice use of the B.F.O. control until the best position above and below the O-line is found. After being located, the same two positions will be used whenever receiving SSB signals.

C.W. Position. This position of the function selector switch is used to receive code. In this position, the automatic gain control is disabled and the BFO is connected in a low output condition. The weaker B.F.O. signal is used so weak station signals will not be swamped. Adjustment of the B.F.O. control changes the pitch of the audible signal.

TUNE Control. The TUNE control, for coarse dialing of the stations, may be stiff when the Receiver is first put to use. Stiffness is deliberate and assures a permanent rigid tuning control — vital to SSB and CW reception during mobile operation.

BAND Selector Switch. The BAND change switch may be rotated continuously in either direction since it controls a revolving turret that has no stops. The operator can change from Broadcast to the 10 Meter Band directly, thus saving wear on five sets of contacts. Operation of the band change switching mechanism is easy and stable because of a gear train which permits switching with a mimimum amount of effort.

VOL. Control. The VOL. control sets the audio to the desired level and, also, switches the power on and off. In SSB operation the audio stage is run wide open with the control set to maximum clockwise position.

CAUTION

The VOL. control power switch has only enough reserve capacity to operate a relay (in the event that a dynamotor or other equipment is to be controlled).

TRIM Control. The TRIM control (antenna trimmer) should be adjusted to give the Receiver peak performance on a signal or on background noise. The

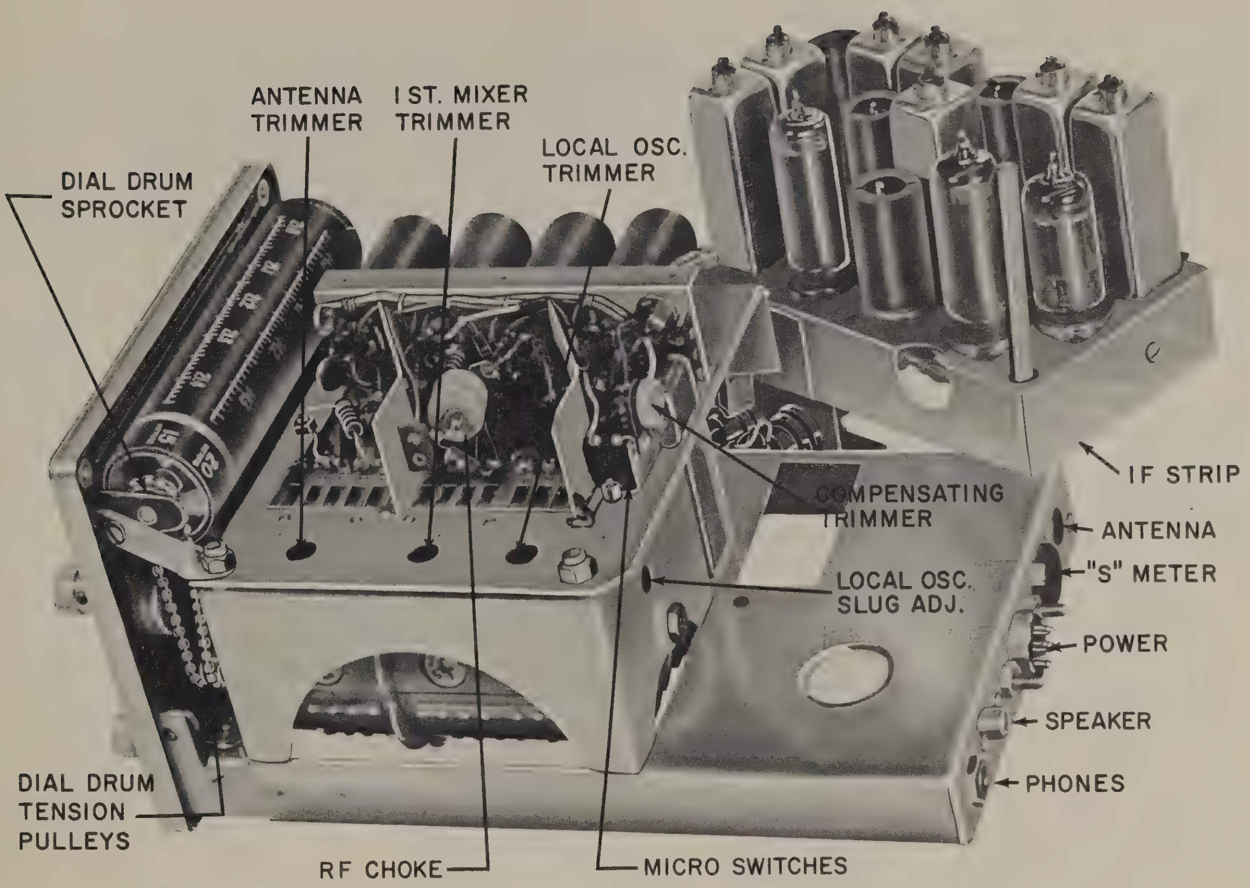


Figure 2. Inside KE-93 Receiver

control should be adjusted whenever the band is changed or when maximum performance is desired over a wide frequency range on some bands. Where the noise level is extremely high, it may be necessary to both reduce the SENS. control (sensitivity) setting and increase the SQUE. control (squelch) in order to tune a peak on the noise. Where an "S" meter is used, adjusting the TRIM control is easily and readily accomplished by tuning for maximum "S" meter reading while receiving a signal with the RECEIVER function switch in the A.M. position and the SENS. control fully advanced (clockwise).

When the red dot on the trim control is pointing straight up, zero antenna and/or line reactance is indicated. Any deviation plus or minus from this point merely indicates that the antenna does not perfectly match the Receiver input of 50 ohms impedance. However, as long as it is possible to reach a signal peak within 90 degrees on either side of this position, no loss of performance will be noted, as the purpose of this control is to tune out any impedance mismatch.

When a perfect match is achieved, the adjustment on the TRIM control becomes quite broad; therefore, an extremely sharp TRIM adjustment indicates that a very large mismatch is present. The control is inoperative on the Broadcast Band and most critical on the 10 and 75 Meter Bands.

SQUE. Control. The SQUE. control is dual purpose, containing both a potentiometer and a switch. The control in the OFF position turns off both the silencer and squelch circuits. Turning the knob clockwise just far enough to snap the switch turns on the silencer with the squelch still inoperative. Optimum position for this control is with the red dot pointing straight up. Under the high air noise conditions, which are prevalent on the lower frequency bands, best results will be obtained by leaving the red dot pointing straight up and decreasing the SENS. (sensitivity) control (counterclockwise) to just the point where background noise ceases or is barely audible when the tuning dial is set to an off-signal position. When driving in and out of high noise areas the sensitivity control (not the SQUE. knob) should be adjusted for best squelching conditions.

The general tendency of most operators is to ignore using squelch in the belief that they may tune past or miss weak signals. This is true of most receivers, but not the KE-93, as the silencer circuit employed assures that the squelch will always *open* on any signal which will be readable, and in many cases in high noise areas on some signals that may not be readable. For AM reception which is the only condition in which squelch functions, it should *always* be used. Aside from its function to remove noise between signals, it also reduces the noise on signals.

SENS. Control. The SENS. (sensitivity) control changes the gain of the first RF and the first IF stages and is active on all functions of the Receiver. The control, except where otherwise instructed in the preceding text, is set to the maximum clockwise position that is compatible with the existing noise level. The front end of the KE-93 Receiver is equipped with a secondary automatic gain control circuit to prevent overloading on extremely strong signals, such as two mobile units operating a few yards of each other. If, under such conditions, overloading does occur, it can be overcome by decreasing the SENS. control in a counterclockwise direction until distortion ceases.

For average air-noise conditions, keep this control full on at all times when receiving AM. When this control is not full on, silencer, automatic gain control, "S" meter (if used) and squelch circuits may not function properly. The only time where there is any advantage in reducing this control from the full-on position is when the ambient noise level is running S6 or better. This usually occurs only on the lower frequency bands. The control range of the sensitivity control must of necessity be very great in order to handle the wide dynamic ranges encountered in CW and SSB reception.

Rear Panel Connections

Rear panel connections (see figures 2 and 4) are clearly marked for identification. The following information is presented so the operator may become familiar with the various applications of the headphone jack and "S" meter plug.

Headphone Jack. Any standard high impedance headphone set, magnetic, dynamic or crystal, may be used. The speaker is automatically disconnected when the earphone plug is inserted.

"S" Meter Plug. This connection is intended for use with an "S" meter which is comprised of a one milliampere meter connected in an appropriate vacuum tube voltmeter and balancing circuits. When this meter is not used, it is necessary that the dummy plug supplied with the Receiver be left inserted. It should be noted that there is a jumper wire between pin 5 and pin 6 on the dummy plug (see figure 4). Pin 6 is ground and pin 5 is used for break in circuits. Opening this connection supplies an instantaneous blanking of the Receiver leaving all voltages normal as necessary for SSB circuits.

CAUTION

Do not attempt to operate Receiver without either the speaker plug inserted and connected to a speaker or without the headphone plug inserted in headphone jack. Oversight on this point may cause damage to the output transformer.

SECTION 3. INSTALLATION

Power Connections

The KE-93 Receiver need not be modified in any way to operate from either a 6 volt, 12 volt D.C. or 110 volt A.C. power pack. All connection changes are made at the power supply end of the power cable. Figure 4 indicates these connections. The Vipac is a combination 6 or 12 volt power pack. Changeover from 6 to 12 volts is made by interchanging the inter-connection plugs furnished, as indicated on the power pack chassis. If power packs other than those normally supplied with the KE-93 Receiver are used, extreme caution should be exercised in the type and quality of such a supply. Due to the high sensitivity of the KE-93, vibrator and/or generator supplies which would normally be satisfactory for other less sensitive receivers may have too high a "hash" or noise output to perform well with the KE-93. The operating B plus voltage for the KE-93 should not exceed 235 volts D.C. at an approximate current of 85 milliamperes. Where power packs other than those normally supplied with the Receiver are used, the warranty on the KE-93 Receiver may be jeopardized.

A.C. Power Pack. The schematic for the A.C. Power Pack (see figure 6) shows a full-wave rectified and filtered type power supply. The pack is equipped with a COMMUNICATION SWITCH on the front panel that opens the high voltage return circuit but leaves the filaments of the Receiver hot — for break-in purposes. Should the operator want this function remoted to a relay by the transmitter circuit, you need only to set the COMMUNICATION SWITCH to the OFF position and connect the remoting circuit to a plug, for this purpose, on the back of the AC Power Pack. It will be necessary to purchase a standard Amphenol 3-pin plug No. 71-3S and connect it to mate the socket in the schematic drawing in figure 6 for remote operation.

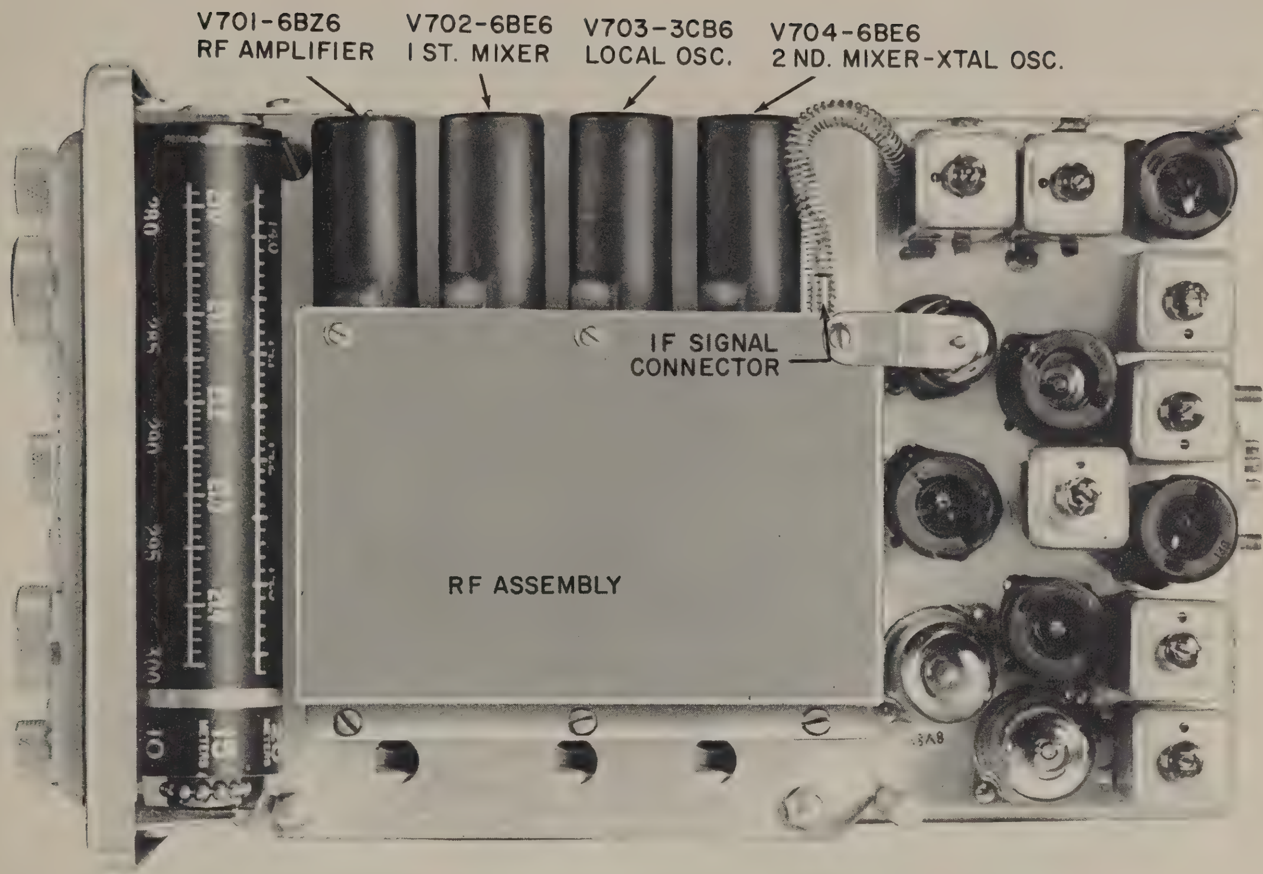


Figure 3. Inside KE-93 Receiver, top view

When the Receiver is used in a fixed station, as shown in figure 1, the interconnecting cable between the Receiver and AC Power Pack is the one shown in figure 5.

Vipac. The dc power supply is a synchronous, self-rectifying vibrator type and is shown in figure 7. Two facts to be determined are: which pole of the car battery is grounded and is the battery 6 or 12 volts.

With these facts known, you next remove the back cover then the top cover of the Vipac. The appropriate 6 or 12 volt rear patch plug can now be inserted. The appropriate 6 or 12 volt front panel patch-plug must also be inserted before installation. For polarity adjustment, the reversible, plug-in vibrator is properly inserted. If the car's battery negative terminal is grounded, the vibrator is inserted so the plus sign (+) is closest to the baffle plate that crosses the center of the power supply chassis. (On most of the filter capacitors, mounted on this baffle plate, the words "battery hot" are stamped. In the above example the positive side of the battery was hot.) If the positive side of battery was grounded, the vibrator would be inserted in reversed position with a minus sign (—) next to the baffle plate. Reassemble the Vipac.

Before mounting the Vipac in the car, be sure to read Vipac instructions. The following provisions must be observed:

1. The cases of the Vipac and Receiver must both be well grounded to the car.
2. The mounting should allow the vibrator to be in the vertical position, for long life and proper operation.
3. The Vipac should be installed as far from the Receiver as possible. If cable lengths, especially to the battery, exceed those furnished, larger wire sizes may be required to prevent voltage drops.
4. The Vipac should not be exposed to splashing water or excessive engine heat when mounting under the car hood (which is a preferable location).
5. Connect the ("A") lead directly to the hot terminal of the battery—*never* to ammeter, ignition switch, or other terminal points. This connection will assure much better regulation from the power source as well as reduce the possibility of noise entering the Receiver through this cable. Be sure

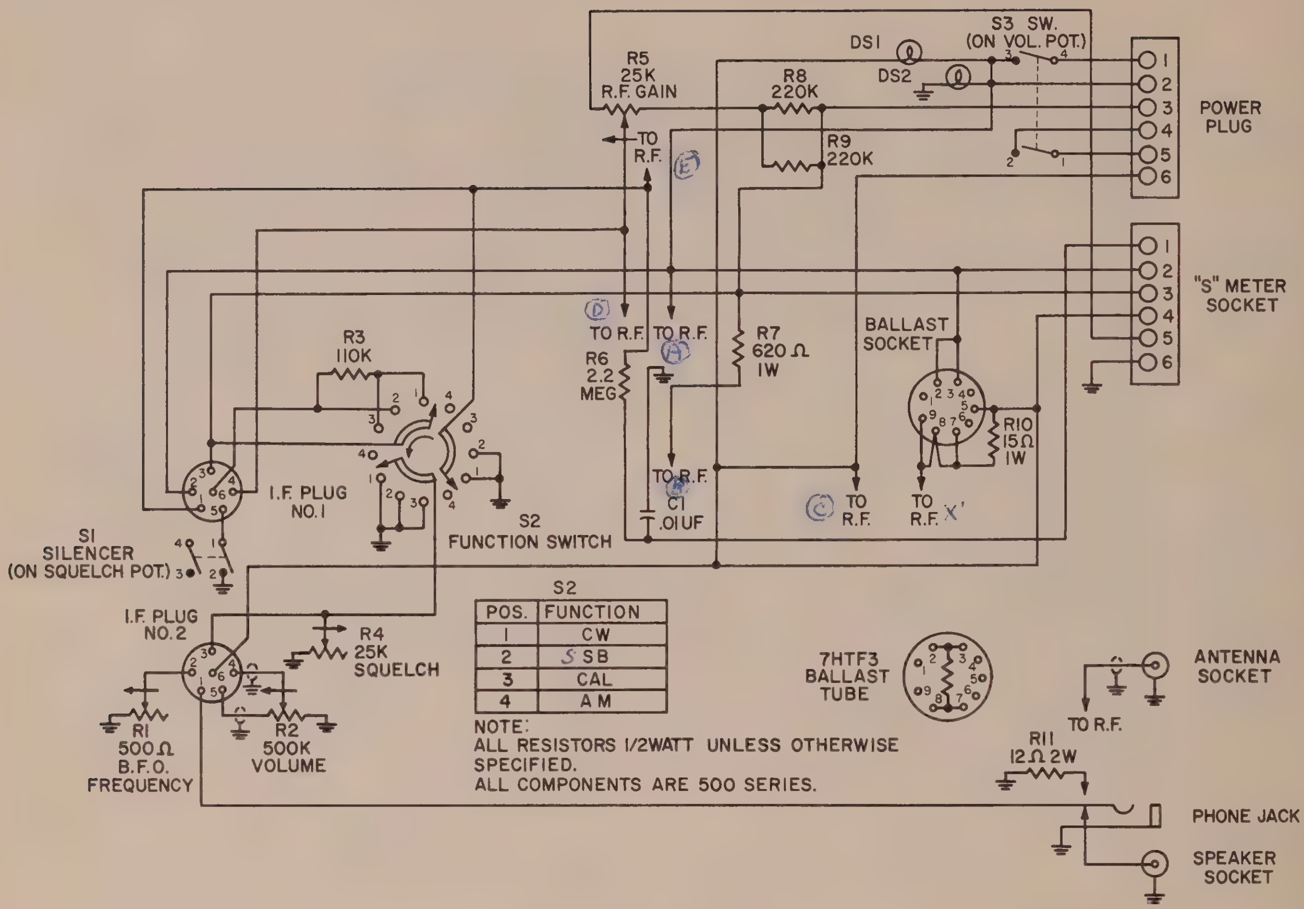


Figure 4. Receiver main chassis, interconnecting diagram

this line is fused if power packs other than those normally supplied with the Receiver are used. This wire should be no smaller than 14 gauge. The information is quite important as under the most adverse conditions, the battery or power source of a 6-volt system may vary from 5 volts to 7½ volts. This variation represents an overall change of approximately 40 percent from normal. The KE-93 is designed to tolerate such a change without serious effects, but no guarantee of performance can be made where this variation is exceeded.

CAUTION

Starting the car engine with the receiver turned on may cause vibrator damage.

Two methods of break-in operation are possible for the mobile station operator. The first method utilizes the plug on front of the Vipac (see figure 7). If the jumper between pins 4 and 5 is removed and the pins connected to the push-to-talk relay of the station, the receiver will be silenced because the high voltage circuit is opened. All the tube filaments remain on, thus allowing fast break-in. The second method allows greater stability of operation and faster switching time. This method is required for SSB voice control and is desirable for AM operation; however, a greater battery drain is experienced because the Vipac is on continuously. In the second method the Vipac plug remains connected and the "S" meter plug on the Receiver is utilized. The jumper between pins 6 (ground) and 5 of the "S" meter plug is then connected to the push-to-talk relay. Whenever the circuit between pins 5 and 6 is open the receiver is instantaneously blanked, even though all other voltage on the tubes remain on and unchanged.

Antenna Input

Since the KE-93 is intended for both mobile and fixed station use, a nominal input impedance of 50 ohms was chosen for all bands, excepting Broadcast Band which is the usual high impedance input necessary for flat receiver sensitivity over the entire band

with a small antenna. Where the transmitting whip is used for reception, best performance of the Broadcast Band will be obtained when the feed line to the antenna is short. The antenna trimmer (TRIM Control) on front panel functions on all bands except Broadcast and permits tuning out reactance where the antenna and/or line impedance is other than 50 ohms. (The antenna impedance varies from 10 to 30 ohms through the bands in the usual car installation.) The resonant transmitting antenna will of course give best performance and should be tuned on each band for receiving, the same as for transmitting.

Mounting for Mobile Use

Universal mounting brackets are provided for mounting the Receiver. The large U bracket is intended for anchoring the back of the Receiver to the firewall or to any other convenient location. The two small brackets are intended for anchoring the front of the Receiver to the under edge of the dashboard. The case of the KE-93 is made of 18 gauge steel with perforated ⅛-inch holes, and therefore is strong enough to be used for mounting at any point on its surface. Size No. 7 sheet metal screws are supplied for mounting the case. When locating brackets on the case, care should be taken so that the screws do not interfere or dig components inside the Receiver.

NOTE

> The KE-93 is inherently stable and will remain so under varying conditions if the car installation is properly made.

When attaching the mounting brackets to the car, use heavy bolts or large sheet metal screws. The car end of these brackets will take up to a ¼-inch bolt. At least two screws should be used to attach the Receiver case to each bracket.

Shock mounting of the Receiver is highly undesirable, since an automobile is already a shock mounted device. The Receiver itself should be attached as *rigidly as possible* to the car body.

The Receiver may be mounted in any orientation.

Noise

Many devices in an automobile are high noise generators and while the KE-93 is equipped with effective silencer and squelch circuits there is no substitute for actually removing the noise at its source. The ignition system, battery charging voltage regulator, and battery charging generator are usually the main sources of noise. Other sources such as turn indicator flashers, electric clocks, tire and/or brake static may also contribute to noise. It is suggested that the various mobile radio amateur handbooks be studied in reference to mobile installations.

To reduce noise from these sources, non-inductive feed-through type capacitors are essential. Packard RADIO 4000 or General Motors RADIO ignition cable is suggested as a possibility for use to eliminate ignition noise. This cable *can* be cut and shortened providing the metal end is first removed and the small brass wire pulled out. After the cut is made, the brass wire must be replaced and the brass end replaced on the cable end to be used. Resistor type spark plugs are also recommended.

The exhaust pipe on most cars float on shock-proof cloth and rubber mountings and can act as an antenna from which motor noise is radiated. A flexible braid bond should be made between the car body and exhaust pipe near its rear or exhaust end. Care should be exercised in obtaining a good tight and clean electrical connection on this bond. Any floating object such as fenders which have anti-squeak cloth pad mountings may also contribute noise and should be tightly electrically connected to the car body.

SECTION 4. MAINTENANCE, DISASSEMBLY, AND ASSEMBLY

Removing Receiver From Case

Receiver should first be removed entirely from vehicle or other mountings. Remove all mounting screws and brackets from case. Remove all plugs and connections from rear of Receiver. Remove the two nuts located on either side of the Power Plug on the rear of aft panel.

Grasp Receiver case firmly in both hands at about the center of the case and place the two screw studs from which the nuts were removed against the edge of workbench or other hard surface. Push hard on case. The Receiver will jump forward about ½ inch until these screws are flush with case back.

CAUTION

> Be sure pressure is being applied to screw only, and not to plug pins.

Set case on bench and hold firmly with left hand. Grasp Receiver front panel with right hand and slowly pull out of case. Take care to keep rear of chassis pushed downward at all times. (On early models using screw IF adjustments observe that IF adjustment screws do not get caught in case ventilating holes.)

Removing RF Coil

Place receiver on side. Turn band selector until desired turret coil is in position for removal (see Band

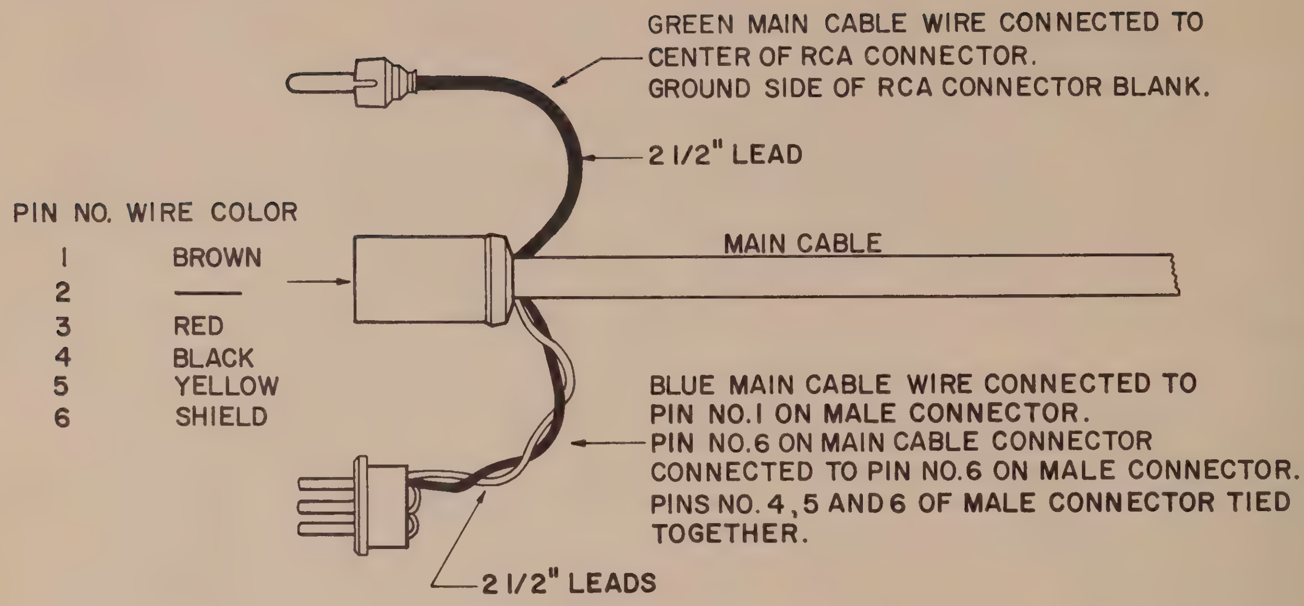


Figure 5. A.C. power cable, Receiver end

— Color Code in Section 1 table). Hold Receiver as shown in figure 8a. Press down on strip with thumbnail and against end plate. Use screwdriver to pry up strip. Remove strip as shown in figure 8c.

Replacing Coil

Replace coil strip by using the reverse procedure as indicated above. Be certain that strip snaps into place before removing pressure from end plate.

Removing IF Strip

Place Receiver on side. Disconnect two plugs from IF strip (see figure 9a). Remove two studs. Disconnect IF signal connector plug. Loosen screw at the top rear of the RF chassis and release the flat spring retainer from the tip of the 6AQ5, audio output tube. Hold top of IF strip in left hand. With right hand in position as shown in figure 9b, grasp bottom firmly and squeeze until sockets on metal bracket snap clear. Lift IF strip straight up toward Receiver top as far as possible, then pull out toward Receiver rear.

CAUTION

Make certain IF connector sockets clear chassis before attempting to lift IF strip upward.

NOTE

IF strip may be secured to chassis and made operative to facilitate IF bottom slug adjustments or other service. Use one stud and nut. Tighten nut with ¼ inch Spintite wrench (see figures 2 and 10).

Ballast Tube

If ballast tube is replaced make certain that rubber "O" ring is located at about the same position as the former tube. The "O" Ring is used to protect the tube from vibration during mobile operation. When Receiver is back in case inspect bottom of Receiver to determine that "O" ring has not slipped from ballast tube. If ring is not in correct position, it may be possible to put it in place with a piece of wire or rod inserted through ventilating holes of case.

Replacing Receiver in Case

When replacing Receiver in case use extreme caution to protect all protruding internal components. When Receiver is approximately ⅓ of the way into the case, observe the shielded wire between IF and RF strip and feed it into the side of the case by hand. Locate the wire between the IF transformer and case (not between IF transformer and the 6AQ5 tube). Be sure it is not caught on edge of case before proceeding. Keep a downward pressure at all times on the chassis until the two rear studs are again located in the rear panel holes. As soon as studs protrude far enough through holes of rear panel, replace nuts and tighten finger-tight.

Hold case and Receiver in lap with panel facing out. Guide the front edge of case into front panel flange and press into place. Tighten rear nuts with Spintite or socket wrench.

Preventive Maintenance

After considerable use, especially in an automobile, it is usually desirable to remove the Receiver from

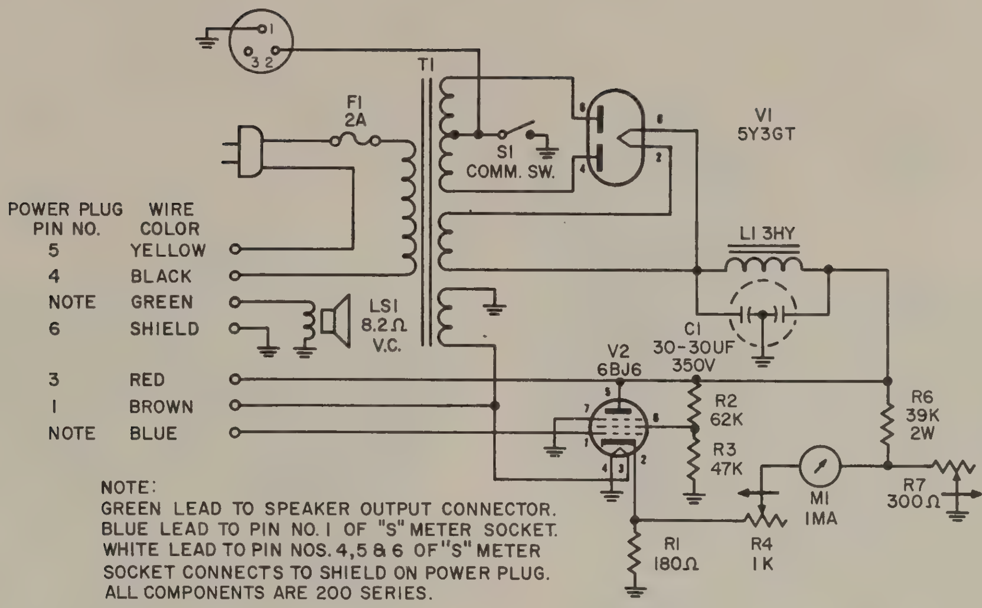


Figure 6. A.C. Power Pack, schematic

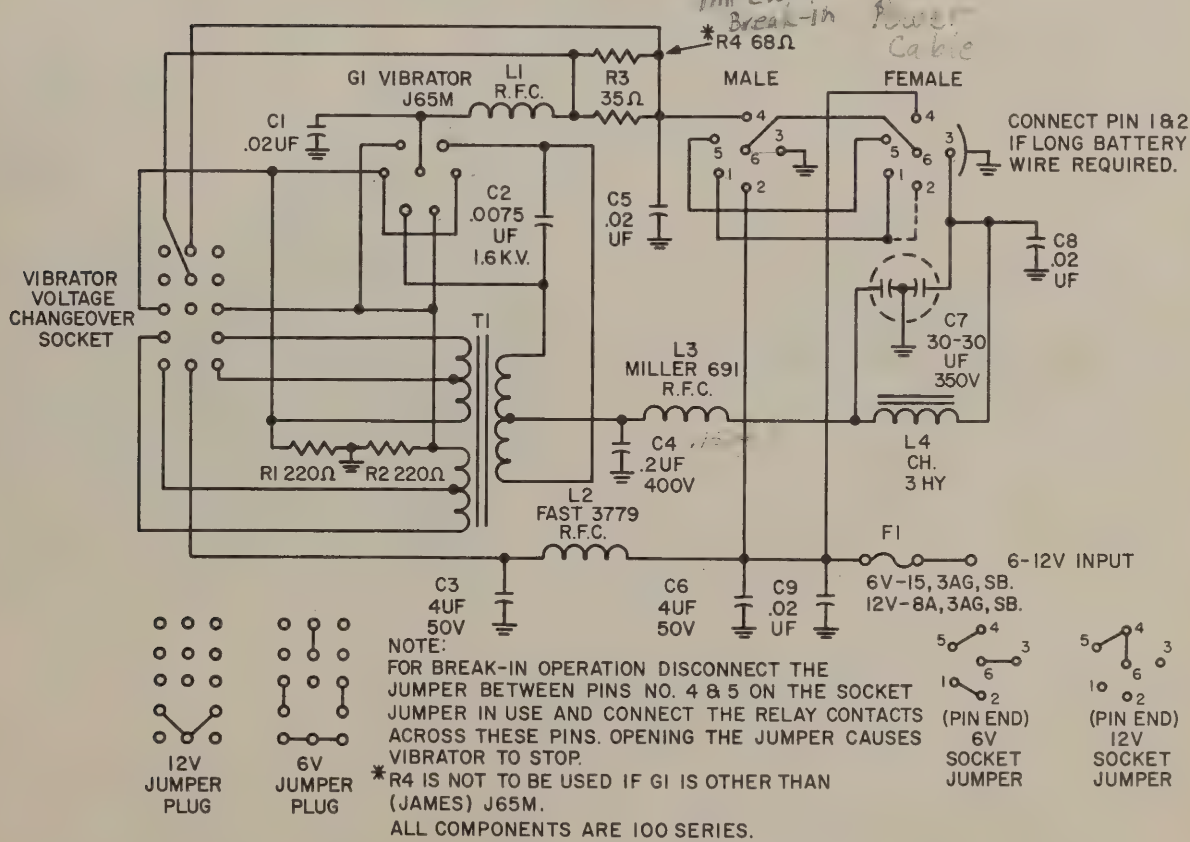
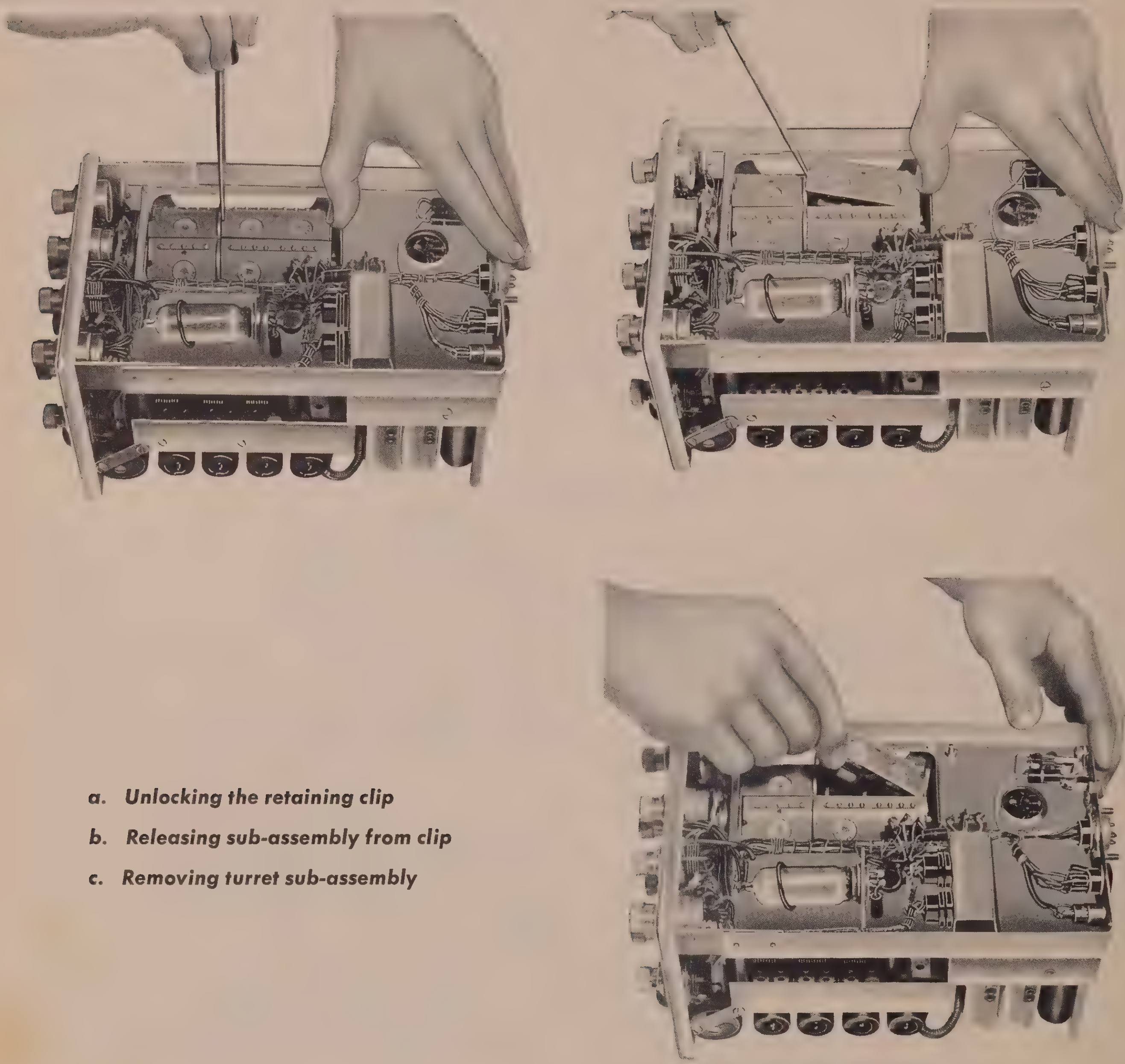


Figure 7. Vipac (D.C. power supply), schematic

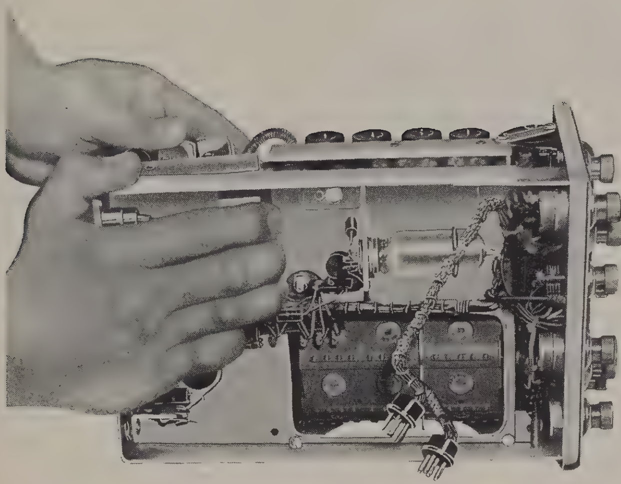


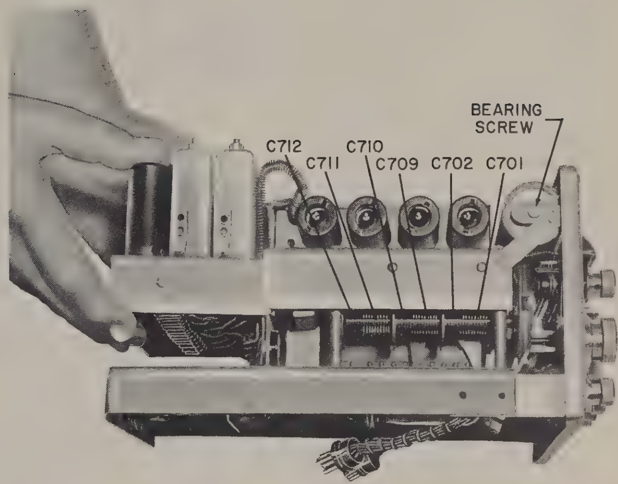
a. *Unlocking the retaining clip*

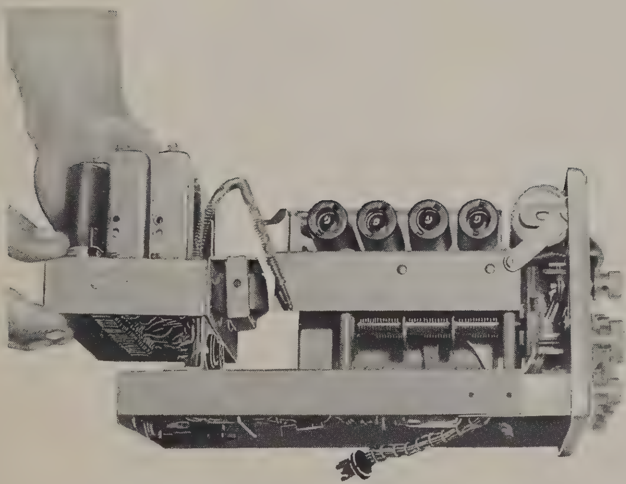
b. *Releasing sub-assembly from clip*

c. *Removing turret sub-assembly*

Figure 8. Removing the RF turret coil







a. Unplugging IF strip connections

b. Lifting IF strip to separate plugs

c. Removing IF strip from Receiver

Figure 9. Removing the IF strip

its case and apply the following maintenance procedures.

Cleaning. A soft paint brush may be used to dust the dial and other Receiver components. Care should be exercised not to hit or bend the dial pointer while cleaning. To clean the dial without removing the Receiver from the car or its case remove the dial window by inserting a sharp pointed tool at the top and center of the window and prying straight out, being careful not to scratch the polished surface. The dial window will pull outward like a bow since it is flexible plastic. This removal should be done at room temperature, not in extremely cold weather, to avoid cracking. The plastic may then be polished with a soft cloth or Kleenex. It is also possible to dust off the dial through the open window with a small paint brush by cleaning one band at a time. Be sure to run the pointer clear up to the low frequency end of the dial before dusting to avoid bending it. To replace the plastic strip, bow it in one hand and insert both ends first, then allow it to snap into place.

The contacts on the turret coil strips should also be cleaned by rubbing them with the forefinger. This can be done with the Receiver turned upside down, rotating the BAND switch as necessary to make all strips accessible.

Lubrication. The turret coil strips should be coated with a light film of Lubri-Plate, applied with the forefinger, after cleaning. Do not over-lubricate. A small amount of Lubri-Plate applied with a paper match stick or small brush to both the top and bottom sides of the front panel dial pointer rail will probably be required. Lubri-Plate comes in a tube and is available from most amateur distributors. All other lubricating should be done with a light oil. Gun oil is preferable and should be applied lightly with a needle point applicator or the eye of a large darning needle. Lubricate the center bearing on all dial cord pulleys, bead chain idler pulleys, bearings at both ends of dial drum, all bearings and wipers on tuning condenser (plates closed, dial tuned to low frequency end), both bearings on tuning knob shaft, bearing on antenna trim condenser and bearing on vernier tune condenser.

Dial Pointer and Cord. After completing the above lubrication the dial pointer should be checked to assure that it is not scraping against the dial or front panel; it must ride free on its slide rail without binding. Check pointer freedom by flipping pointer back, away from the rail, when it is about at dial center with the thumb nail or a sharp pointed tool. The pointer should snap back into place without assistance and lift evenly from the rail when pushed away at its dead center. Do this checking operation cautiously and gently so as not to bend the pointer. A binding pointer may be freed by holding it tightly to the rail with the finger and inserting a thin knifeblade between the bottom tabs and the rail, thus bending the tabs slightly to provide clearance. Only a very small amount of bending should be required, if at all. Next, check all pulleys concerned with the dial cord to be sure they are turning freely. In rare cases one of the small front panel pulleys may be riveted too tightly. It may be freed by using a small screwdriver as a pry-bar under the pulley and against the edge of the panel to lift its center pin just enough to provide clearance. Make this adjustment cautiously so as not to pull the pin clear out or damage pulley.

Controls. VOL., SENS., B.F.O., and SQUE. controls may, after considerable exposure to dust and dirt, become electrically noisy in use. This condition can be corrected if treated as soon as noticed and before the carbon control surface has been seriously damaged by grit. A drop of Quietrol applied to each control under its cover at the terminal opening will in most cases correct the noise condition if the control knob is worked back and forth immediately, as this will flush out the dirt as well as lubricate. Earlier model Receivers use a curved spring washer underneath the control knobs. This extra tension helps keep the controls clean and quiet. A little light oil applied to these springs will relieve friction or binding. The tension of these springs may be controlled by loosening the set screw, pushing the knob with thumb to desired tension, then re-tightening the set screw. One or two tries may be necessary to obtain the desired result. Quietrol is available at most amateur distributors.

Replacement Dial Parts

Dial Cord. The dial cord will wear for a very long period of time and may never require replacement. This cord is made of special material: temperature insensitive, no long or short term stretch, short bending radius, and excellent abrasion characteristics. The cord should only be replaced with one supplied by the factory, which comes cut to proper length with spring attached. Installation of a new cord appears difficult. Actually, it is quite simple. Some narrow scotch masking tape and a crochet hook will prove very helpful. The installation is accomplished with the tuning condenser fully meshed (maximum capacity). The dial cord loop is hooked into the hook provided for it on the large pulley of the tuning condenser. Use the masking tape to bind this pulley in place. Start routing the cord through the proper path using the crochet hook. Use small pieces of masking tape to hold cord in place.

When the cord has been routed through most of its path it should be attached to the front panel tuning shaft. Place crochet hook under the exposed end of a small spring wire laying in a slot at the top of the front bearing of the tuning knob shaft and lift it gently, at the same time pulling outward on the front panel knob. This spring wire lays in a slot in the shaft and when lifted high enough permits the knob and shaft to be pulled out. With the shaft about half-way removed, leaving the small end free for manipulation, first wind three loops of cord around your left forefinger and, holding cord between finger and thumb to prevent loop from unwinding, transpose the loops to the exposed end of the tuning shaft. The shaft is then reinserted to its proper position lifting up on the

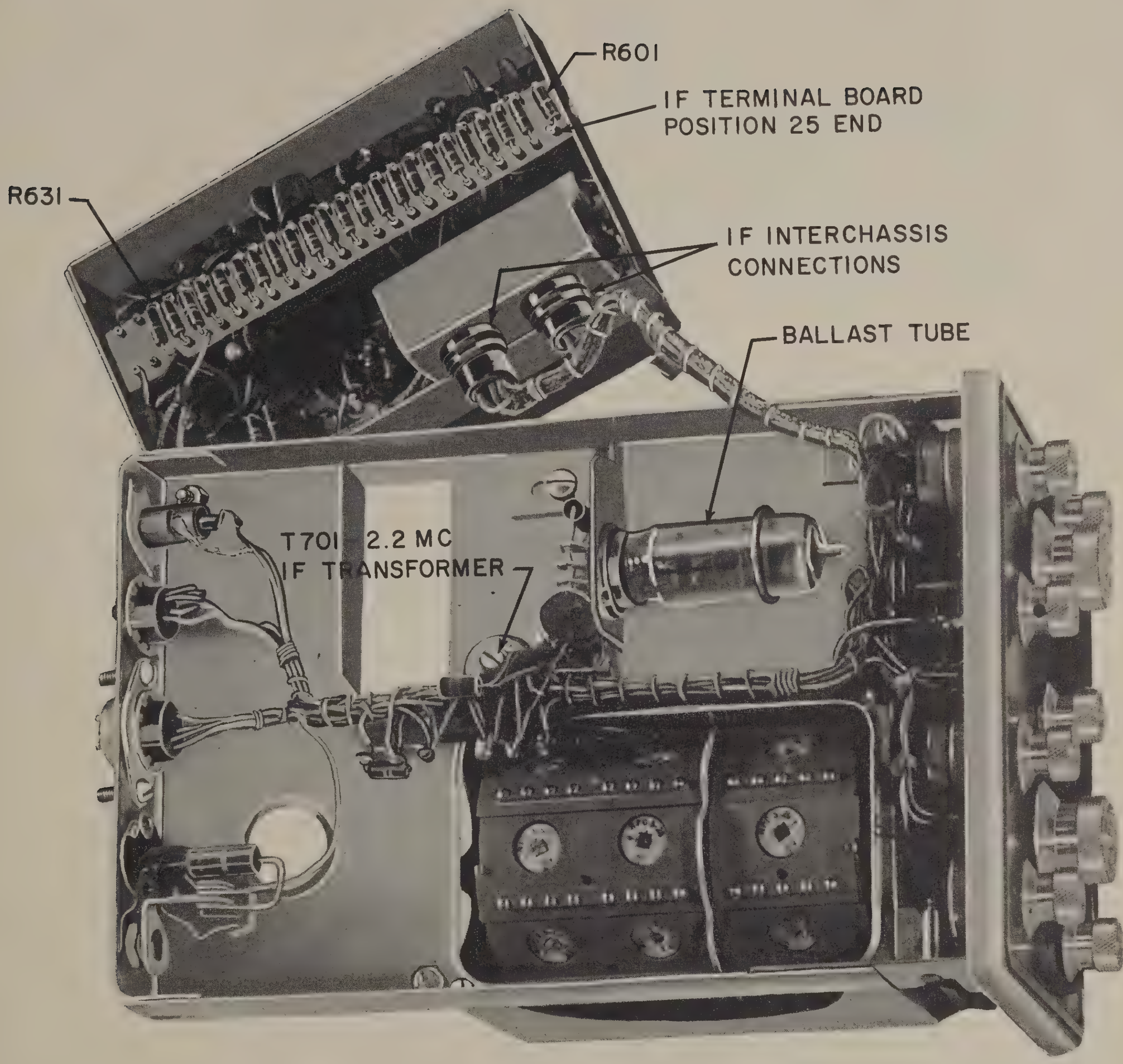


Figure 10. Inside Receiver, bottom view

small spring wire, if necessary. Be sure that the small spring wire snaps into its proper slot. Final positioning and routing of the dial cord may now be done. Now, hook the dial cord spring over the hook provided for it on the main tuning condenser pulley. Now check cord and all pulleys to see that cord is still properly positioned. Should the spring appear to be stretched to more than one and one-half times its unstretched length, it should be hooked into another hole in the main condenser pulley. Remove all the scotch tape and check for free running condition and freedom from backlash. Push the pointer to the low frequency end of the dial, just touching the small panel pulley. Be sure tuning condenser plates are still fully meshed. Hook the pointer over the cord and cement in place with household cement. Allow sufficient time for the cement to dry. Check for smooth and free running condition of pointer and freedom from backlash (see dial notes under maintenance section).

NOTE

> When winding the loops of cord over the finger for insertion over the tuning knob shaft the wind should be made underhand. In the event this was done overhand, the pointer will travel opposite from the direction the TUNE knob is turned. This condition does no harm but to most operators is undesirable.

Pilot Light Bulbs. The bulbs used in the KE-93 are of the 5000 hour type hence will rarely require replacing. However, if necessary the following procedure should be used. First, note the band on which the Receiver is set, and then, with a pointed tool or hook, lift up on the bead chain at the top of the dial drum sprocket (see figure 2). Lifting the chain high enough and outward, hook it over the dial drum bracket thus keeping tension against its load spring but freeing the dial drum. Next, run dial pointer to extreme low frequency end of dial (any band). Remove bearing screw at the opposite end of dial drum (see figure 9b). Pull straight up on the free end of drum using care so as not to damage dial surface. This permits you to lift out the dial drum leaving pilot lights exposed. Replace pilot light.

The dial drum is reinserted in the opposite procedure from removal. Pay no attention as to the relation of the dial to BAND switch setting when reinstalling. When bead chain has been put back in place over sprockets, use your fingers to force dial drum back to the original band position. The dial will move in jumps as the bead chain jumps sprocket positions. Should any minor dial drum-to-window positioning be desired, it can be made using a set screw in the drum hub at the opposite end from the sprocket. Loosening this set screw frees the drum on its shaft; hence, it is possible to align the drum to any position and lock it by re-tightening set screw.

Alignment Procedure

General. The KE-93 is a dual conversion super heterodyne receiver. The methods of alignment are quite conventional with but few exceptions. No alignment should be attempted without proper tools and signal generators. The only special tool that will be required is a Walsco No. 2543 hex-tuning tool, available at most radio parts dealers. Wherever possible insulated screwdrivers should be used particularly when making tuning adjustments to the antenna, mixer or oscillator circuits. Before attempting alignment the Receiver should be partly disassembled as shown in figure 2 and thus making all adjustments accessible. Be sure the IF signal lead as well as the main power connectors underneath the IF strip (see figures 3 and 10) are properly seated in their connectors before turning on the Receiver. Read instructions in Section 4 on proper method of disassembly and assembly. Before aligning, allow 30 minutes for Receiver warm-up.

NOTE

> Earlier Receivers have adjustment screw slots both top and bottom of all IF transformers, later models may have a mixture of both screw adjustments on bottom and hex-hole slugs on top. Current models have hex-hole slugs both top and bottom of all transformers. Current models slugs may be tuned from the upper side of the chassis by passing the slender end of the Walsco No. 2543 hex-tuning tool all the way through the upper slug to tune the bottom slug. This, of course, applies to all IF transformers of the current type in which case it is possible to align the IF transformers without removing the IF strip from the main chassis.

IF Alignment Procedure. The first step is to align the low frequency IF channel. If the Receiver is connected to the A.C. Power Pack, the "S" meter therein may be used as the vacuum tube voltmeter for all alignment procedure. If this is not the case, it will be necessary to connect a standard VTVM (vacuum tube voltmeter), set on a negative 10 volt scale, to the automatic gain control bus (the gray wire which runs throughout the Receiver and is available on the terminal board on the bottom of the Receiver or at the "S" Meter socket on rear of chassis). Set the front panel controls in the following manner: SENS. control to maximum clockwise, RECEIVER switch to A.M., VOL. control to ¼ to ½ clockwise, BAND switch to band 1 (Broadcast) position, TUNE dial to 550 kc, and SQUE. control to maximum counterclockwise (silencer switch snapped OFF). Connect signal generator output to the outer end of the RF choke on the top of the RF section (see figure 2). (There is plate voltage on this Receiver terminal; therefore, a 0.02 uuf. or larger, condenser should be inserted between this terminal and the signal generator output-lead to avoid shorting the high voltage through the signal generator.) Always use the minimum output of the signal generator that will allow a good meter indication, reducing it from time-to-time as the tune-up proceeds.

Adjust tuning adjustments on transformers T601 and T602 (see figure 11) both top and bottom for

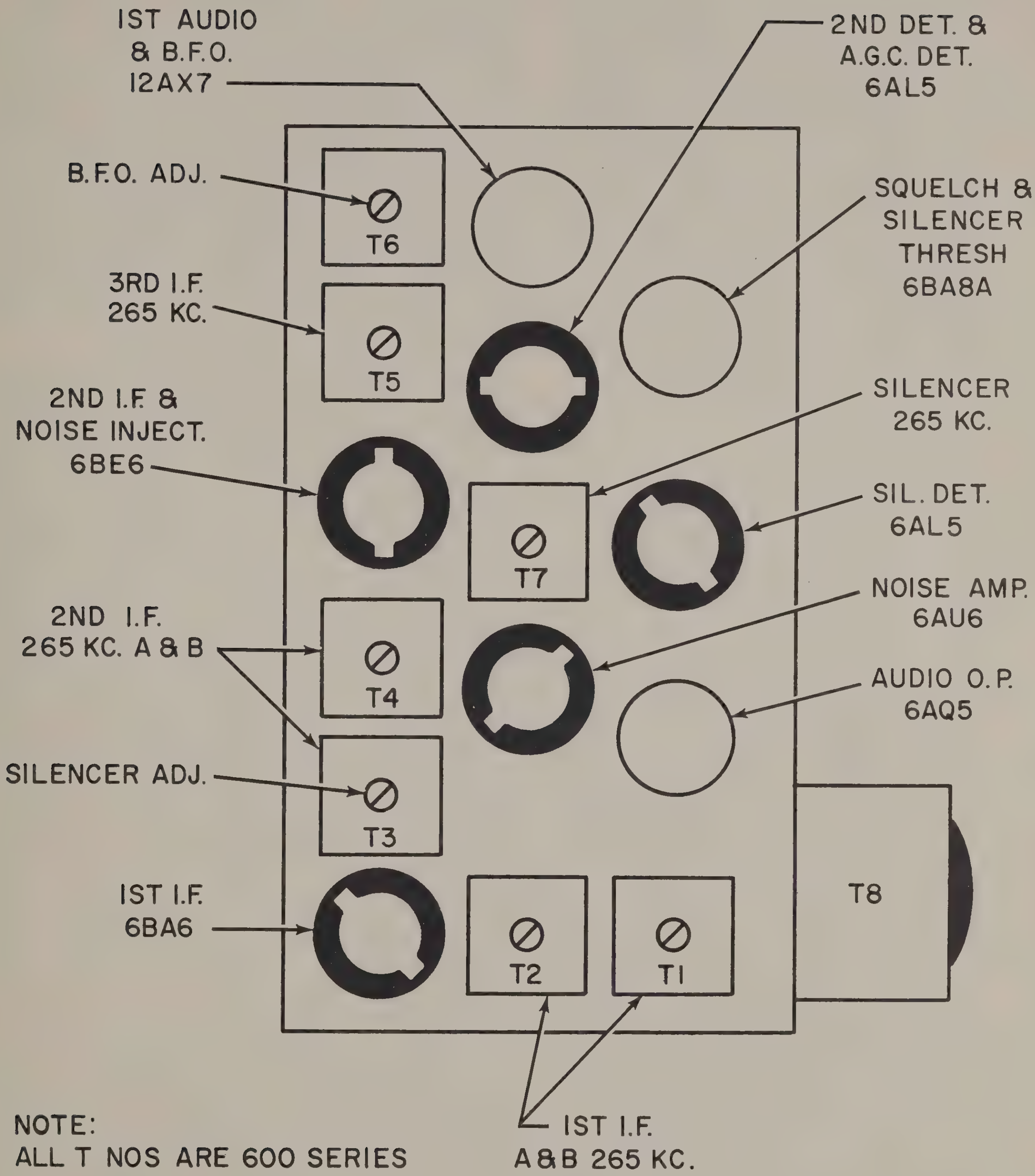


Figure 11. IF strip, identification of components

maximum meter reading. Next, adjust the *bottom trimmer only* of T603 and then top and bottom of T604 and T605 for maximum reading. Repeat all above adjustments one or more times to make sure that maximum meter reading has been attained. Now, adjust *top trimmer* only of T603 for maximum *dip* in meter reading. This adjustment concerns the silencer and will be further discussed under that section.

Turn RECEIVER switch to CAL. position, reduce signal generator output and if necessary the SENS. control to a point where the meter reading drops nearly, but not quite, to zero. An audible whistle should now be heard as the B.F.O. pitch control on the front panel is rotated. Set B.F.O. knob red dot to the O-line marking and then adjust the top adjustment of T606 for zero beat. Rotating the B.F.O. knob straight up or straight down should now produce about the same pitch of beat note on either side of O-line. If not, reduce signal generator output further and readjust as before.

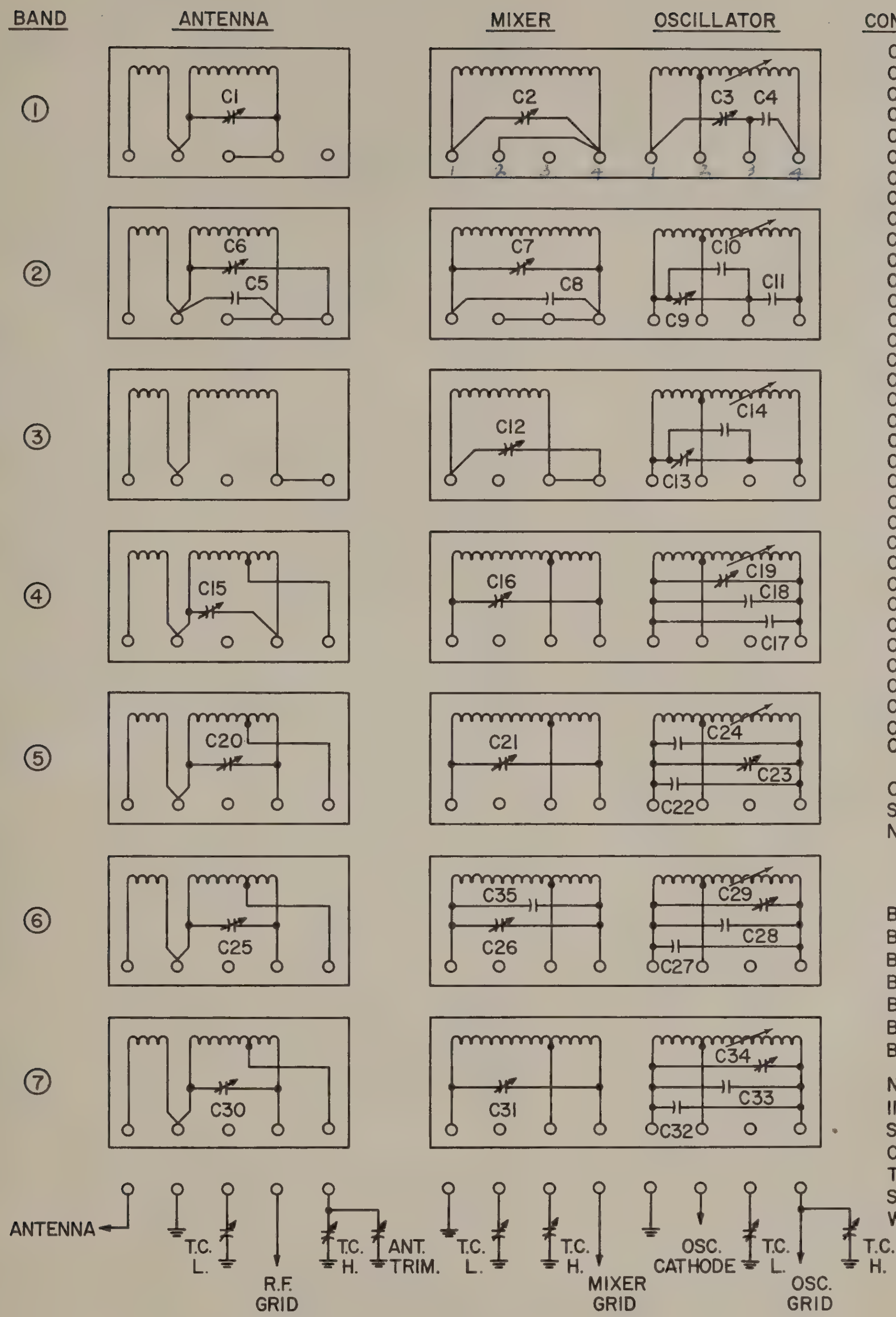
Before proceeding with final alignment return SENS. control to full clockwise position, set RECEIVER switch to A.M. position, set BAND switch to band 5 or band 6 and adjust compensating trimmer (see figure 2) at top rear of RF assembly for maximum meter reading. (This trimmer is no longer required on later models so if trimmer is missing, ignore this adjustment.)

Final tune-up of the IF section concerns completion of the silencer adjustment. Remove the signal generator connections from the Receiver but not the vacuum tube voltmeter, if used. Attach an outside antenna and tune to any point between stations preferably where considerable noise can be heard. Next snap SQUE. switch to on. Do not advance beyond switch snapping point. Tune both top and bottom slugs of T607 for minimum meter reading and/or minimum audible noise. Next, tune in an audible AM signal of about S4 or S5 level. This signal will probably be quite distorted at this stage of adjustment. Slowly unscrew counterclockwise the top adjustment on T603 just to the point where distortion barely ceases. This completes the silencer adjustment which should now perform well on signals of any level. In the event you hear distortion in later use, you need only to unscrew top of T603 adjustment a trifle more. This re-adjustment can usually be accomplished through one of the ventilation holes with either a small screwdriver or tuning tool without removing Receiver from case.

The final stage of IF alignment is to align the 2.2 mc dual conversion IF transformer (T701) located on the RF section (see figure 10). Alignment of this stage is made best on a signal fed into the antenna terminal, preferably on the third band (80 Meters). (In no case attempt to tune up T701 with bandswitch on Broadcast or 160 Meters as the circuits involved are inoperative on these bands.) The signal used may be an on-the-air signal, providing no excessive fading is present, or the signal generator. After carefully setting the TUNE dial to a maximum meter reading, reduce the signal generator output or SENS. control for mid-scale meter reading. Adjust T701 by tuning both top and bottom slugs for a maximum meter reading. (In earlier models, the upper slug is only accessible with the RF cover removed and then only with a very slender screwdriver over which a piece of insulating sleeving has been placed, exposing only the tip.) Care should be exercised to be sure that T701 is aligned for maximum meter reading while accurately tuned for the received signal. It is possible, in some cases, to tune T701 to the crystal oscillator frequency involved with this circuit. In this case a high meter reading will be obtained but no audible signal. Check for misalignment by tuning the main tuning dial back and forth across the received signal. If correctly aligned, the meter reading will fall to zero or near zero when the TUNE dial is moved.

The foregoing instructions complete the IF alignment; however, the following information will be helpful in obtaining the desired maximum end-result. Earlier model Receivers, which have only screw slot adjustments on both top and bottom of the IF transformers, can be tuned only to the correct position insofar as the top slug is concerned. However, wherever hex-hole slugs are used it is possible to tune each slug in one of two positions. One, the outer positions where the slug is entering the coil from the outer ends of the IF transformers; and two, where the slug has passed clear through the coil and reaches resonance toward the center. Since the slug is now approaching the other coil in the opposite end of the transformer the fields are pulled in that direction and the transformer is now coupled tighter or closer than before, creating an increase in bandwidth. This effect can be of a decided advantage in achieving a bandwidth according to the user's taste. Earlier models were always tuned with both slugs in the outer position producing narrowest bandwidth. This bandwidth proved to be much too selective for most users; hence, current models tune all slugs in the outer position except T601 and T602 wherein the upper slugs of these two transformers are tuned to the inner peak. In no case should both the upper and lower slugs be tuned to the inner peaks of any transformer as this will produce over-coupling to the extent of creating a double tuning peak.

Where earlier models are found to be too selective, the corrective alignment may possibly be made on transformers T601 and T602 by tuning the bottom slugs to the inner peak. Usually it is not possible to do this on the upper slugs as the brass tuning studs have been cut off to permit the Receiver to enter its case. When IF alignment is first attempted there will be doubt as to which of the two possible peaks the IF transformer is tuned, because initially it will not be far from correct alignment. The inner and outer peaks found on any individual slug by first unscrewing (counterclockwise) the slug as far as it will go then slowly tuning back in (clockwise) locating the first peak then the second one (as indicated on the meter), then backing up to or stopping on the one desired.



CONDENSER VALUES

C1	3-12 PF.	(O)
C2	3-12 PF.	(O)
C3	5-25 PF.	(O)
C4	750 PF.	(S)
C5	12 PF. 5%	(S)
C6	5-25 PF.	(O)
C7	5-25 PF.	(O)
C8	31 PF.	(S)
C9	3-12 PF.	(O)
C10	43 PF.	(N)
C11	1800 PF.	(S)
C12	5-25 PF.	(O)
C13	3-12 PF.	(O)
C14	20 PF.	(N)
C15	5-25 PF.	(O)
C16	5-25 PF.	(O)
C17	91 PF.	(S)
C18	36 PF.	(N)
C19	5-25 PF.	(O)
C20	5-25 PF.	(O)
C21	5-25 PF.	(O)
C22	120 PF.	(S)
C23	3-12 PF.	(O)
C24	15 PF.	(N)
C25	5-25 PF.	(O)
C26	5-25 PF.	(O)
C27	200 PF.	(S)
C28	36 PF.	(N)
C29	5-25 PF.	(O)
C30	5-25 PF.	(O)
C31	5-25 PF.	(O)
C32	30 PF.	(S)
C33	15 PF.	(N)
C34	3-12 PF.	(O)
C35	10 PF.	(S)

CODE

O=NEGATIVE, POSITIVE-ZERO.
S=SILVER MICA.
N=NEGATIVE TEMPERATURE COEFFICIENT. (N750)

FREQUENCY COVERAGE

BAND 1	550-1650 KC.
BAND 2	1650-3500 KC.
BAND 3	3500-4030 KC.
BAND 4	6990-7310 KC.
BAND 5	13970-14360 KC.
BAND 6	20990-21450 KC.
BAND 7	27950-30000 KC.

NOTE:
INDIVIDUAL SETS MAY HAVE SLIGHTLY DIFFERENT VALUE CONDENSERS INSTALLED AT THE FACTORY. ALL CONDENSERS ±2% UNLESS OTHERWISE SPECIFIED.
ALL COMPONENTS ARE 300 SERIES.

Figure 12. Turret assembly, schematic

RF Alignment and Calibration. RF alignment of the Receiver is easily done; however, frequency calibration is a matter which requires extreme care and the proper equipment. The ideal piece of equipment is a 100 kc crystal calibrator and harmonic generator which will produce harmonics every 100 kc throughout the radio spectrum thus providing a marker for every major calibration point on every band. An additional oscillator and harmonic generator located at 3.55 mc is also very helpful. The 3.55 mc oscillator can be any tone-modulated signal generator or oscillator capable of high harmonic output, because its purpose is to produce an identifying marker adjacent to the lowest frequency 100 kc marker on each amateur band. This identification will prevent confusion and the possibility of miscalibrating any given band by an error of from 100 to 200 kc. Normally a correction of only a few kilocycles is necessary when recalibrating the Receiver. If extreme caution is used danger of adjusting the local oscillator trimmers incorrectly can be avoided.

To proceed with alignment and calibration, first disassemble the Receiver in the manner described for IF alignment where the IF strip is mounted outside of the main chassis (see figure 2) to permit access to the back of the tuner turret for adjustments. As in alignment of the IF strip, utilize the "S" Meter or provide a VTVM that is connected to the automatic gain control bus. Set the Receiver controls in the following manner: SENS. full clockwise, VOL. ¼ to ½ clockwise, RECEIVER switch A.M. position, red dot on VER. control pointing towards center of panel, red dot on TRIM control pointing straight up toward top of panel, SQUE. control to OFF position (extreme counterclockwise, switch off), and BAND switch on band 1 (Broadcast Band). Feed calibrator signals into antenna connector with short piece of coaxial cable with a few inches removed from free end. Attenuation of the signals must be provided (in the event the calibrators are not equipped with attenuators, the exposed end of the antenna lead may be placed in their vicinity and moved about) until about a half scale meter reading is obtained.

The first step is to tune across the Broadcast Band noting the location of the marker signals, which should appear at every 100 kc of dial reading. On this band, it isn't likely that much adjustment will be required. The markers normally used at the factory for calibration are those occurring at 1500 kc and 600 kc. The local oscillator trimmer may be adjusted through the hole in the top of the RF strip as shown in figure 2. In tune-up on the turret assembly it is not possible to accidentally make adjustments on the wrong trimmers or slugs (a band which is not in use) as the only trimmer and slug adjustments accessible are those on the band indicated by the dial. Move the local oscillator trimmer a very small amount to determine which way the marker moves in relation to the dial calibration. The direction of motion may vary from band to band. A little practice will help you adjust this trimmer for dial calibration to the marker. Next, tune the dial pointer around 600 kc to locate its marker. In the event the marker falls nearer the low frequency end of the dial than it should, it will be necessary to adjust the end slug in the oscillator coil as indicated in figure 2. Turning the slug in (clockwise) moves the marker toward the high frequency of the band whereas unscrewing (counterclockwise) moves the marker toward the low frequency of the band. Each time the slug adjustment is changed, it will be necessary to readjust the trimmer position at the high frequency or 1500 kc end and then repeat the entire operation sufficient times to place both markers on their respective correct dial readings. Once the dial calibration has been achieved, it is necessary only to peak the adjustment of both the mixer and antenna trimmers (see figure 2) for maximum meter reading when the Receiver is tuned to the 1300 kc marker.

The same procedure is followed for each individual band excepting the 80 Meter Band, which has no antenna trimmer adjustment (adjustment being accomplished by the front panel trimmer). When tuning all bands except 80 Meters, the red dot on the antenna trimmer (TRIM control) should be left pointing straight up and not changed. In every case on all bands from 80 Meters and higher, the two major markers at the extreme ends of the dial should be used for calibration: for example 4.0 and 3.5 (mc) on 80 Meters. In all cases, from 80 Meters and higher frequencies look for the 3.55 mc harmonic plus the 100 kc marker adjacent to and below it, thus assuring that the correct 100 kc marker has been chosen for the low frequency end of each band.

It will be noted, that when the mixer-trimmer is tuned there will be some interaction on the local oscillator frequency. This condition becomes progressively more noticeable as each successively higher-frequency band is tuned-up. Once the mixer-trimmer is peaked for maximum signal on a band by moving the TUNE dial as necessary to stay on the signal oscillator frequency further adjustment of the mixer-trimmer will not be required. It may be necessary to reset the local oscillator-trimmer for correct dial calibration at the high frequency end of the dial, particularly on the 15 Meter Band. If the 15 Meter Band cannot be peaked, merely turn the TUNE dial away from the marker signal near the high frequency end of the dial. Peak the mixer-trimmer, in this case, for maximum noise as heard in the speaker and possibly indicated on the meter. Readjust the local oscillator-trimmer for correct calibration.

On the higher frequency bands it may be possible to set the mixer and/or antenna trimmer to the wrong side of the local oscillator frequency thereby producing what appears to be correct frequency yet it is actually 4.4 mc high in frequency. An air check on amateur signals will readily reveal this condition. In this case, the second tune-up peak on antenna and mixer trimmers must be made. It will not be necessary to change the local oscillator frequency any appreciable amount to accomplish this, except for minor calibration correction.

On tuning-up the 10 Meter or 7th Band, extreme care must be exercised so as not to get lost, since there are twenty 100 kc markers spaced across this band. Here the harmonic marker from the 3.55 mc oscillator will prove invaluable in locating the 28 mc marker.

In making any of the above adjustments you should bear in mind the fact that the Receiver has been initially and correctly adjusted at the factory; hence, only minor touch-ups of any of the adjustments involved should ever be necessary. Drastic turning and twisting of adjustments may result in getting any given band so far out of line it becomes a major project to reestablish correct settings without additional equipment such as used in a radio factory. Should any band fail to tune up properly using only minor adjustments, other defects should be looked for before proceeding, such as faulty trimmers, soldered connections on the coils, etc. Should it be necessary to remove any of the coils from the turret for examination the instructions in this section and of figures 9 and 12 should be made and followed to avoid damage of the components or upsetting the initial adjustments. The color code used on the turret coil strips is standard, same as for resistors, brown being band 1, etc.

A final word of caution, bear in mind that since a harmonic generator is utilized for calibration that the basic frequency of 100 kc must be very accurate because 30 mc is the 300th harmonic of 100 kc. Any error in the basic oscillator frequency will be multiplied by 300 at this frequency. Harmonics of this oscillator should be checked on a receiver capable of receiving and checking against one of stations WWV (Bureau of Standards) transmissions at 5, 10, 15, and 20 mc. Radio-service type generators or oscillators are not accurate enough for calibration purposes. The same is true of most expensive laboratory type signal generators except where they are regularly checked for calibration by precision methods.

"S" Meter Adjustment. The "S" meter circuit incorporated in the A.C. Power Pack is in actuality a logarithmic vacuum-tube volt-meter operated by automatic gain control voltage. It may be necessary from time to time to re-balance this circuit for proper calibration. This is best accomplished with the power supply removed from its case. Apply power to the Receiver for 15 minutes. Set the Receiver controls as follows: BAND switch to band 3 (80 Meters), RECEIVER switch to A.M. position, VOL. control $\frac{1}{4}$ to $\frac{1}{2}$ open, and SENS. control to OFF (completely counterclockwise) position. There are two screwdriver adjustments on the top of the A.C. Power Pack chassis. With the panel facing toward the operator the left adjustment marked MINIMUM should be adjusted until "S" meter pointer rests on zero. Next, remove the 6BJ6 tube from its socket and adjust the right-hand adjustment marked MAX until "S" meter pointer rests at maximum reading, the infinity mark. Replace tube, wait for 5 minutes, and repeat the entire procedure one or more times, if necessary. Finally, rotate the SENS. control to extreme clockwise position resetting the righthand or maximum meter adjustment as necessary. This completes "S" meter adjustment.

There are two snap buttons in the top of the power supply case. Removal of these buttons will permit access to the previous adjustments made without removing the power supply from case. It will of course be impossible to remove the 6BJ6 tube under these conditions, so another method must be employed. A zero meter set adjustment is accomplished as previously described. To set the maximum or infinity position of the "S" meter needle, it will now be necessary to advance SENS. control full clockwise position and tune in the strongest signal that can be found in the Broadcast Band. Then adjust the right hand adjustment for infinity reading on the meter. Repeat one or more times if necessary. This latter method is not as accurate as the first method described but satisfactory for most purposes.

Should it at any time be necessary to replace the 6BJ6 (V202) tube it should be noted that these tubes are subject to aging characteristics. Factory tubes are aged approximately 12 hours prior to installation by lighting their filaments at normal voltage and allowing them to burn for this period with no plate voltage applied. Should an unaged tube be installed, it will be necessary to rebalance the meter circuit every few days until the tube finally settles down.

SECTION 5. TROUBLE SHOOTING

Where a Receiver is completely inoperative two methods will be helpful in locating the source of trouble, particularly with reference to the IF section. Method 1: Make voltage and resistance measurements as indicated in figure 13. Method 2: Can often provide a very quick check in locating the circuit area of fault. Turn the Receiver on for a period of about one or two minutes with the IF strip mounted on the side as explained in this Section. Next, turn the Receiver off and run forefinger slowly across the resistors on the resistor board (see figure 10). Should any resistor feel excessively warm, this is obviously an indication of a short or fault. Reference to the resistor numbers on figure 13 and the schematic diagram (figures 14 and 15) will immediately indicate the circuit involved and the probable cause. Should R601 indicate excessive temperature it is probable that there is a short or ground in the IF signal connector, plug or jack. This is the shielded lead that connects between the RF and IF Sections (see figure 3).

CONTROL	VOLTS	OHMS
Volume	Low Level	Off
Squelch	Off	Off
Sensitivity	Full Clockwise	Full Clockwise
Function	A.M.	A.M.
B.F.O.	0–	0–
Band	Broadcast	Broadcast
Tuning	Strong Signal	Any
Vernier	Any	Any
Trim	Any	Any

OHMS	VOLTS	POSITION	VOLTS	OHMS	RESISTOR
500K	.5	1	0	300	—
∝	0	2	0	∝	—
∝	–.5	3	–.5	∝	R31(47K)
128K	175	4	225	18K	R27(110K)
5M.	–5	5	–7	242K	R20(4.7M)
220K	–7	6	–8	242K	R18(22K)
220K	–7	7	0	0	R19(220K)
1M.	–5	8	–4	2M	R22(1M.)
18K	225	9	220	23K	R16(4.7K)
18K	225	10	145	90K	R15(62K)
470K	0	11	0	490K	R12(22K)
470K	0	12	0	0	R13(470K)
0	0	13	3	2K	R11(1.6K)
23K	205	14	225	18K	R10(4.7K)
2M	–5	15	–3	2.1M	R9(100K)
300	2	16	0	0	R7(300Ω)
90K	130	17	225	18K	R8(62K)
0	0	18	4	2.2K	R21(2.2K)
330	12	19	4	2K	R28(4.7K)
18K	225	20	220	23K	R6(300Ω)
0	0	21	.5	300	R2(100K)
2.1M	–3	22	–5	2M	R6(4.7K)
0	0	23	95	36K	R3(47K)
18K	225	24	95	36K	R5(62K)
18K	225	25	220	23K	R1(4.7K)

The above voltage measurements are made with a 20,000 ohms-per-volt voltmeter.

Some older models may have a deviation from above chart, in that R31, R27 and R20 are moved back one position, leaving position 5 blank.

Figure 13. Voltage and resistance measurements, IF chassis

TROUBLE SHOOTING CHART

Symptom or Fault	*Circuits Involved*	*Probable Cause and Cure*
Receiver inoperative bands 1 and 2.	Microswitches (see figure 2).	Sticking switch actuator. Oil lightly and check actuator spring operation.
Receiver inoperative bands 3, 4, 5, 6 and 7.	Same as above. Second mixer V704 tube circuits.	Same as above. Check V704 tube. Check 2.2 mc transformer T702.
Receiver produces noise all bands but no signals.	V703 local oscillator tube circuit.	Check V703 tube, 7HTF3 ballast tube, and circuits.
Receiver weak on one or two bands but operative on others.	Coils in turret assembly involved.	Antenna and mixer trimmers out of adjustment. See alignment procedures.
Receiver off calibration on one or more bands.	Local oscillator bands involved.	See alignment procedures for proper calibration.
Receiver sensitivity low all bands.	RF and IF stages.	Check all tubes involved including mixers. See IF alignment procedure.
Spurious carriers or birdies on 10 Meter Band.	Local oscillator and RF stage.	Probably defective 3CB6 tube V703. Replace. Also replace V701 (6BZ6) tube.
Distortion of AM signals when silencer turned on.	Silencer circuits and V602, V605, V606, and V607.	Silencer pick-off set too deep. See alignment instructions.
Silencer ineffective when turned on.	Same as above.	Check tubes involved and see alignment instructions.
Regeneration or oscillation on all bands.	RF and IF stages.	Check or replace V701 (6BZ6), V601 (6BA6), V605 (6AU6) and V602 (6BE6). Check circuits involved.
Noisy volume or other operating controls.	Various.	Check spring tension under knobs, where used. See maintenance instructions.
TUNE knob and pointer backlash or play.	Tuning mechanism.	See maintenance instructions.
TUNE knob turns hard or freezes.	Tuning shaft bearings.	See maintenance instructions.
Microphonic noises when Receiver jarred.	Electro-mechanical.	Probably defective tube, tap tubes individually until located.
Vibrator hash in mobile installation.	Vipac.	Poorly grounded Vipac or Receiver case. "A" lead not connected directly to battery. Faulty vibrator.
Poor or weak reception of Broadcast Band in mobile installation.	Antenna Installation.	Usually caused by long lead to antenna. Short low capacity lead in gives best results.

SECTION 6. PARTS LIST

The operator should not undertake any form of repair of the Receiver unless he is thoroughly experienced. If necessary, the manufacturer should be consulted for correct procedures involving operational discrepancies. Replacement parts should be those indicated in the following list. Deviations from parts specified can cause inefficient operation and also the loss of warranty protection.

Main Chassis Interconnections

- IF Plug No. 501 — Amphenol #86CP6S or equiv.
- IF Plug No. 502 — Amphenol #86CP6S or equiv.
- S501 (Silencer Sw. on SQUE. control) — R504
- S502 (RECEIVER Function Sw.) — Mallory #3234 or equiv.
- S503 (Power Sw. on VOL. control) — R502
- DS501-T 51 — General Electric or equiv.
- DS502-T 51 — General Electric or equiv.
- Ballast Tube — Amperite #7HTF3 or equiv.
- Power Plug — Amphenol #78 PCG6F or equiv.
- "S" Meter Socket — Amphenol #78 S6S or equiv.
- Antenna Socket — Cinch #8611 or equiv.
- Phone Jack — Mallory #A3A or equiv.
- Speaker Socket — Cinch #8134 or equiv.
- R501 — 500 ohm, ½ W
- R502 — 500K, ½ W
- R503 — 110K, ½ W
- R504 — 25K, ½ W
- R505 — 25K, ½ W
- R506 — 2.2M, ½ W
- R507 — 620 ohms, 1 W
- R508 — 220K, ½ W
- R509 — 220K, ½ W
- R510 — 15 ohms, 1 W
- R511 — 12 ohms, 2 W
- C501 — .01 uf

RF Circuit

- RF Terminal Bd. — Automation Electronics Inc. #53-715
- Mixer Terminal Bd. — Automation Electronics Inc. #53-717
- Oscillator Terminal Bd. — Automation Electronics Inc. #53-717
- V701-6BZ6 (RF Amplifier)
- V702-6BE6 (1st Mixer)
- V703-3CB6 (Local Oscillator)
- V704-6BE6 (2nd Mixer and Crystal Oscillator)
- T701 — Automation Electronics Inc. #53-702
- L701 — Automation Electronics Inc. #53-728
- Y701 — Midland #ML-6W or equiv.
- S701 ("A" and "B") — Milliswitch #B-2D or equiv.
- IF Connector — Cinch #14H-12699 or equiv.
- *C701 — T.C.L.
- *C702 — T.C.H.
- C703 — 100 uuf
- C704 — 2.8-23 uuf
- C705 — .02 uf
- C706 — .01 uf
- C707 — .02 uf
- C708 — 5 uuf
- *C709 — T.C.L.
- *C710 — T.C.L.
- *C711 — T.C.H.
- *C712 — T.C.H.
- C713 — 220 uuf
- C714 — .02 uf
- C715 — 100 uuf
- C716 — .01 uf
- C717 — .01 uf
- C718 — .02 uf
- C719 — .005 uf
- C720 — .02 uf
- C721 — 12 uuf
- C722 — 100 uuf
- C723 — 2 uuf
- C724 — 2.5-10.5 uuf
- R701 — 4.7M, ½ W
- R702 — 180 ohms, ½ W
- R703 — 82K, ½ W
- R704 — ....
- R705 — 47K, ½ W
- R706 — 68 ohms, ½ W
- R707 — 18K, ½ W
- R708 — 470 ohms, ½ W
- R709 — 1K, ½ W
- R710 — 27K, ½ W
- R711 — 47K, ½ W
- R712 — 100K, ½ W
- R713 — 47K, ½ W
- R714 — 560 ohms, ½ W
- R715 — ....
- R716 — 100K, ½ W

* On common shaft — T.C.L. — 10.7 uuf and T.C.H. — 290.8 uuf.

Turret Tuner

- Osc. Mixer Band 1 — Automation Electronics Inc. #53-317
- Osc. Mixer Band 2 — Automation Electronics Inc. #53-318
- Osc. Mixer Band 3 — Automation Electronics Inc. #53-319
- Osc. Mixer Band 4 — Automation Electronics Inc. #53-320
- Osc. Mixer Band 5 — Automation Electronics Inc. #53-321
- Osc. Mixer Band 6 — Automation Electronics Inc. #53-322
- Osc. Mixer Band 7 — Automation Electronics Inc. #53-323
- Antenna Band 1 — Automation Electronics Inc. #53-324
- Antenna Band 2 — Automation Electronics Inc. #53-325
- Antenna Band 3 — Automation Electronics Inc. #53-326
- Antenna Band 4 — Automation Electronics Inc. #53-327
- Antenna Band 5 — Automation Electronics Inc. #53-328
- Antenna Band 6 — Automation Electronics Inc. #53-329
- Antenna Band 7 — Automation Electronics Inc. #53-330

IF — Audio Circuit

T601 — Automation Electronics Inc. #53-608
T602 — Automation Electronics Inc. #53-607
T603 — Automation Electronics Inc. #53-609
T604 — Automation Electronics Inc. #53-607
T605 — Automation Electronics Inc. #53-610
T606 — Automation Electronics Inc. #53-611
T607 — (Output Trans.) 5000: 8.2 ohms — Automation Electronics Inc. #53-610
T608 — Automation Electronics Inc. #53-613
V601-6BA6 (1st IF Amplifier)
V602-6BE6 (2nd IF Amplifier and Noise Injection)
V603-6AL5 (2nd Detector and Delayed AGC)
V604-12AX7 (1st Audio Amplifier and BFO)
V605-6AU6 (Noise Amplifier)
V606-6AL5 (Noise Detector and Overshoot Clipper)
V607-6BA8A (Automatic Noise Threshold and Squelch Control)
V608-6AQ5 (Audio Output)
IF Plug No. 601 — Amphenol #78-S6S or equiv.
IF Plug No. 602 — Amphenol #78-S6S or equiv.
R601 — 4700 ohms, ½ W
R602 — 100K, ½ W
R603 — 47K, ½ W
R604 — 300 ohms, ½ W
R605 — 62K, ½ W
R606 — 4700 ohms, ½ W
R607 — 300 ohms, ½ W
R608 — 62K, ½ W
R609 — 100K, ½ W
R610 — 4700 ohms, ½ W
R611 — 1600 ohms, ½ W
R612 — 22K, ½ W
R613 — 470K, ½ W
R614 — 470K, ½ W
R615 — 62K, ½ W
R616 — 4700 ohms, ½ W
R617 — 1M, ½ W
R618 — 22K, ½ W
R619 — 220K, ½ W
R620 — 4.7M, ½ W
R621 — 2200 ohms, ½ W
R622 — 1M, ½ W
R623 — 1M, ½ W
R624 — 22K, ½ W
R625 — 100K, ½ W
R626 — 2200 ohms, ½ W
R627 — 110K, ½ W
R628 — 4700 ohms, ½ W
R629 — 330 ohms, 1 W
R630 — 470K, ½ W
R631 — 47K, ½ W
R632 — 47K, ½ W
C601 — .01 uf
C602 — .02 uf
C603 — .01uf
C604 — .02 uf
C605 — .01 uf
C606 — .1 uf, 75 v.
C607 — .02 uf
C608 — .01 uf
C609 — .01 uf
C610 — .01 uf
C611 — .1 uf
C612 — 390 uuf
C613 — .02 uf
C614 — 390 uuf
C615 — .02 uf
C616 — .002 uf
C617 — .01 uf
C618 — 390 uuf
C619 — .01 uf
C620 — 5 uf
C621 — 100 uf
C622 — 100 uuf
C623 — .02 uf
C624 — .02 uf
C625 — 12 uf, 25 v.
C626 — .01 uf
C627 — 100 uuf
C628 — .01 uf
C629 — 10 uf, 25 v.
C630 — .005 uf
C631 — 390 uuf
C632 — .005 uf
C633 — .02 uf

Vipac

Male Connector — Amphenol #86CP6S or equiv.
Female Connector — Amphenol #78PCG6 or equiv.
F101 — 6 volts, 15A — 12 volts, 8A
G101 — James #J-65M or equiv.
Voltage Changeover Socket — Cinch #13220 or equiv.
6 and 12 volts Jumper Plugs — Cinch #13219, Amphenol #91MPF6L or equiv.
T101 — Automation Electronics Inc. #53-114
L101 — Automation Electronics Inc. #53-116
L102 (RFC) — Fast 3779 or equiv.
L103 (RFC) — Miller 691 or equiv.
L104 (Choke) — Automation Electronics Inc. #53-132
R101 — 220 ohms, ½ W
R102 — 220 ohms, ½ W
R103 — 35 ohms, 10 W
R104 — 68 ohms, 2 W
C101 — .02 uf
C102 — .0075 uf, 1.6 kv.
C103 — 4 uf, 50 v.
C104 — .2 uf, 400 v.
C105 — .02 uf
C106 — 4 uf, 50 v.
C107 — 30-30 uf, 350 v.
C108 — .02 uf
C109 — .02 uf

AC Power Pack

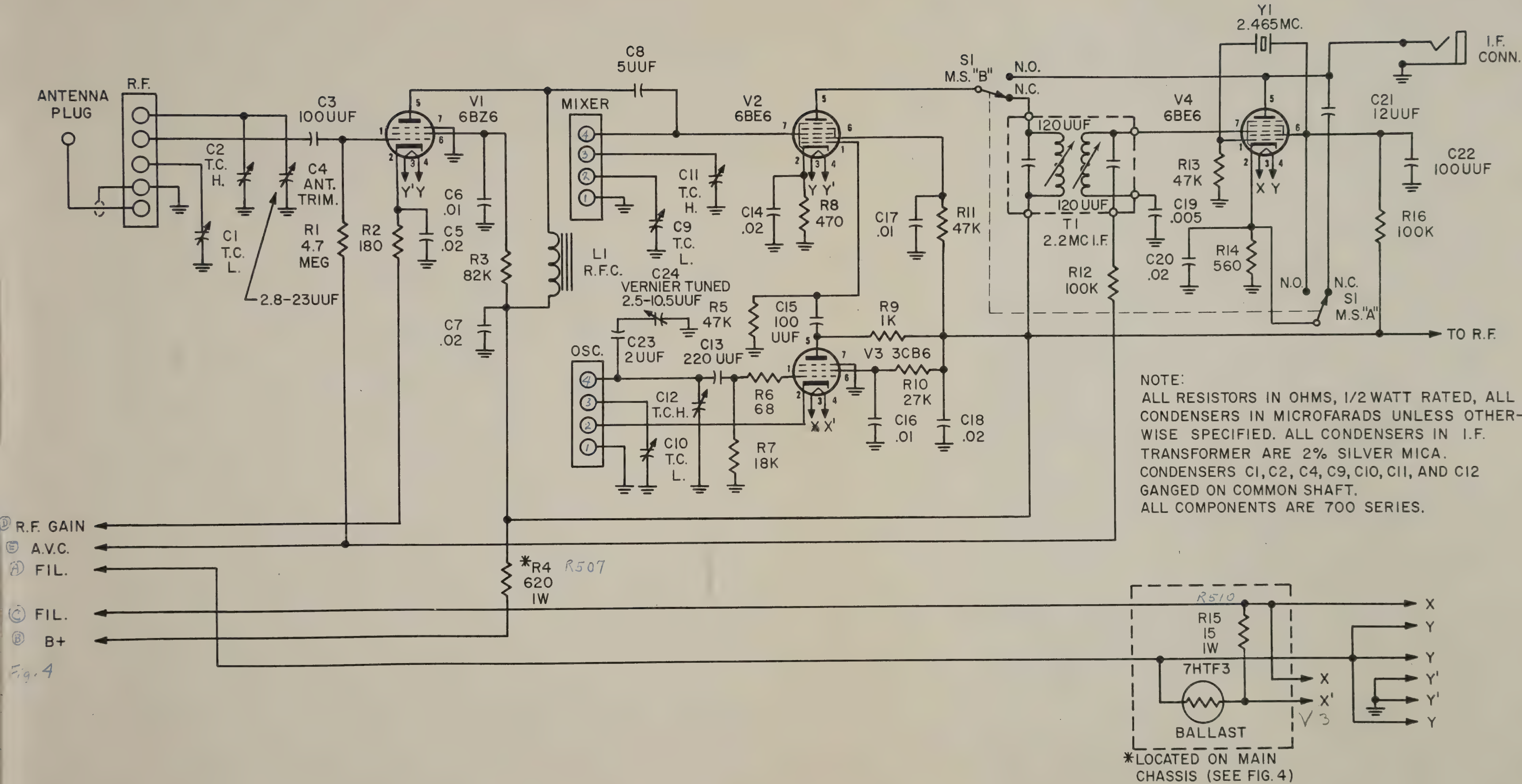
Power Plug — Amphenol #91MPF6L or equiv.
F201 — 2A
V201-5Y3GT (Rectifier)
V202-6BJ6 ("S" Meter Amplifier)
S201 (COMMUNICATION SWITCH) — AH & H #570 or equiv.
LS201 (8.2 ohm Voice Coil) — Oxford #XB718 or equiv.
T201 — Automation Electronics Inc. #53-212
L201 — Automation Electronics Inc. #53-132
M201 — 0-1 Milliampere
R201 — 180 ohms, ½ W
R202 — 62K, ½ W
R203 — 47K, ½ W
R204 — 1K, ½ W
R205 — ....
R206 — 39K, 2 W
R207 — 300 ohms, ½ W
C201 — 30-30 uf, 350 v.

NOTES

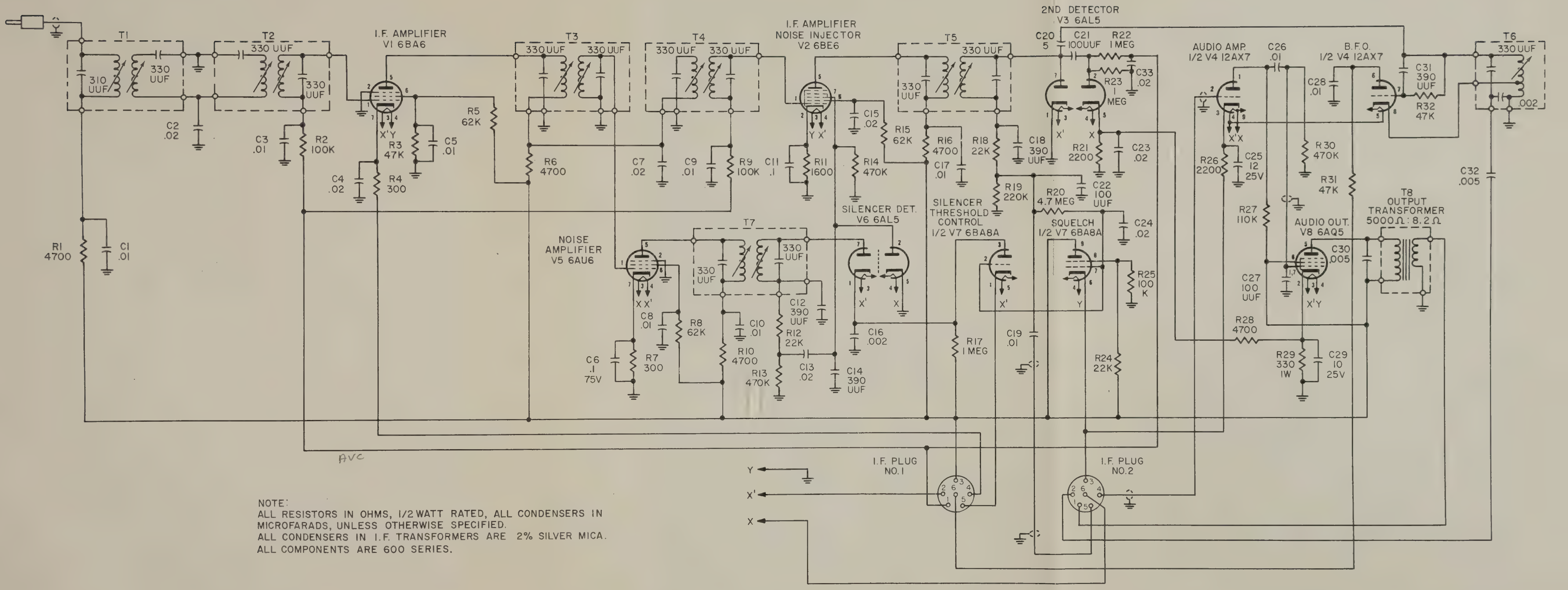
Fig. 4

Figure 14. RF Chassis, schematic

NOTES



NOTE:
ALL RESISTORS IN OHMS, 1/2 WATT RATED, ALL CONDENSERS IN MICROFARADS UNLESS OTHERWISE SPECIFIED. ALL CONDENSERS IN I.F. TRANSFORMER ARE 2% SILVER MICA.
CONDENSERS C1, C2, C4, C9, C10, C11, AND C12 GANGED ON COMMON SHAFT.
ALL COMPONENTS ARE 700 SERIES.



NOTE:
ALL RESISTORS IN OHMS, 1/2 WATT RATED, ALL CONDENSERS IN MICROFARADS, UNLESS OTHERWISE SPECIFIED.
ALL CONDENSERS IN I.F. TRANSFORMERS ARE 2% SILVER MICA.
ALL COMPONENTS ARE 600 SERIES.

Figure 15. IF Chassis, schematic

NOTES

NOTES

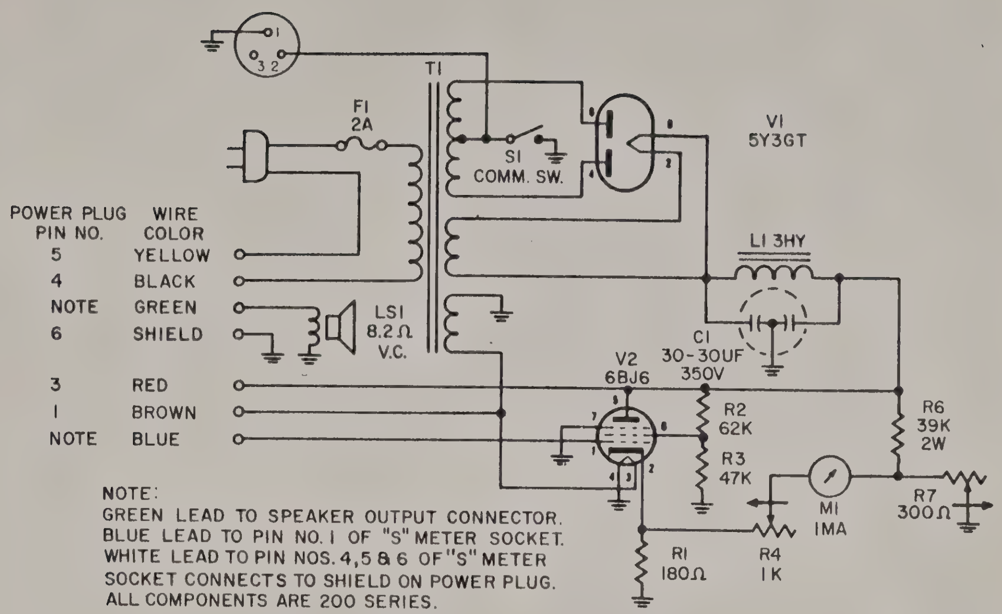


Figure 6. A.C. Power Pack, schematic

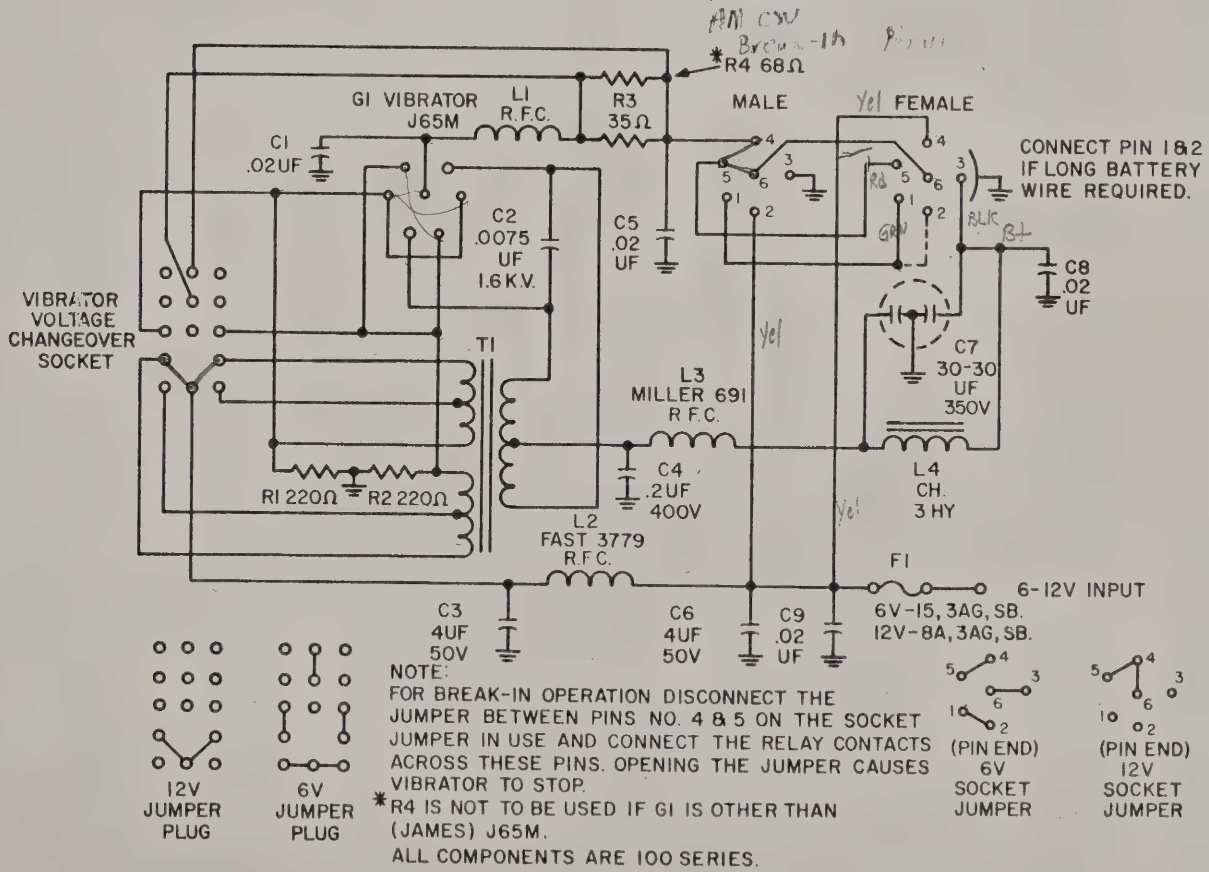


Figure 7. Vipac (D.C. power supply), schematic

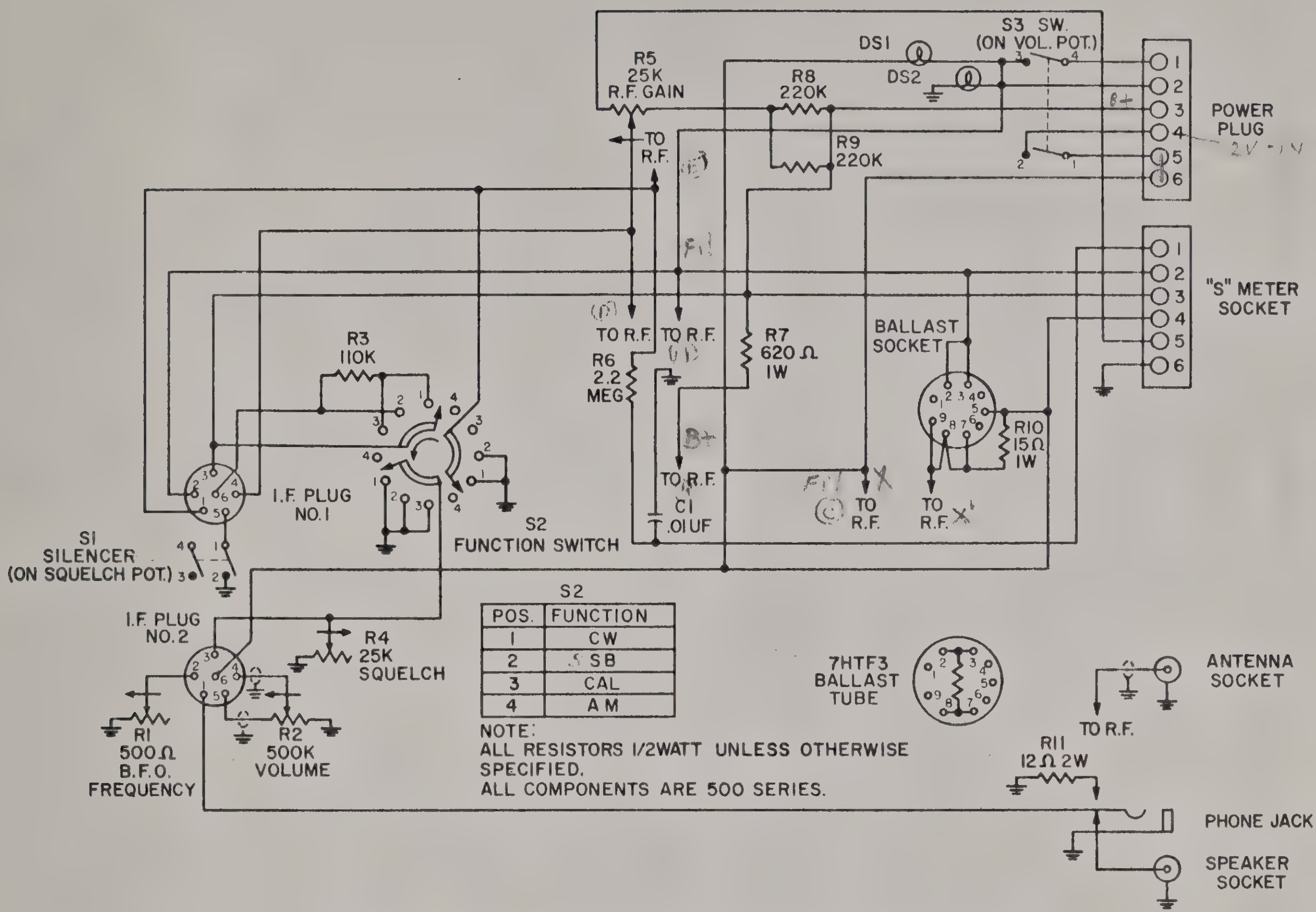


Figure 4. Receiver main chassis, interconnecting diagram

this line is fused if power packs other than those normally supplied with the Receiver are used. This wire should be no smaller than 14 gauge. The information is quite important as under the most adverse conditions, the battery or power source of a 6-volt system may vary from 5 volts to 7½ volts. This variation represents an overall change of approximately 40 percent from normal. The KE-93 is designed to tolerate such a change without serious effects, but no guarantee of performance can be made where this variation is exceeded.

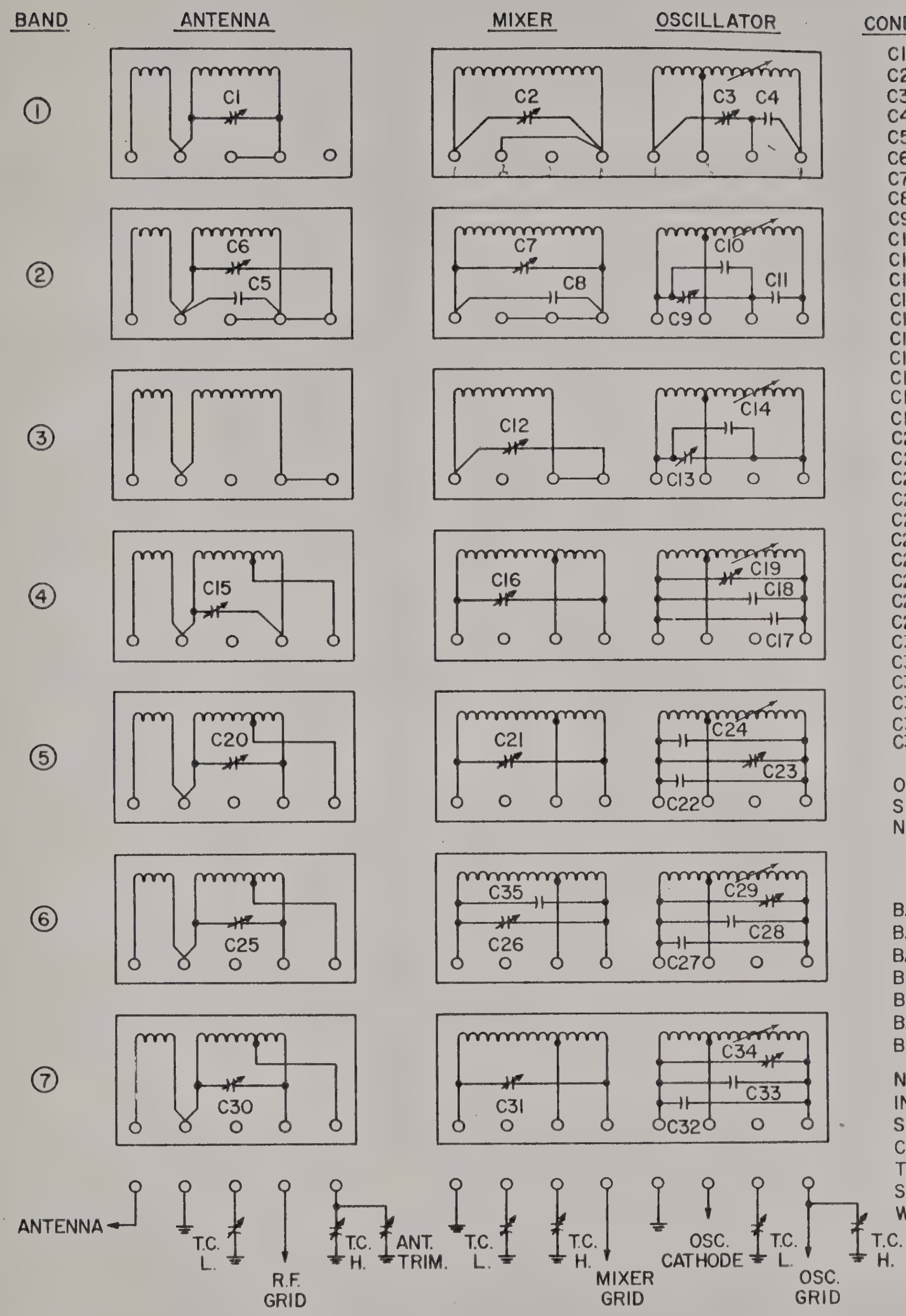
CAUTION

Starting the car engine with the receiver turned on may cause vibrator damage.

Two methods of break-in operation are possible for the mobile station operator. The first method utilizes the plug on front of the Vipac (see figure 7). If the jumper between pins 4 and 5 is removed and the pins connected to the push-to-talk relay of the station, the receiver will be silenced because the high voltage circuit is opened. All the tube filaments remain on, thus allowing fast break-in. The second method allows greater stability of operation and faster switching time. This method is required for SSB voice control and is desirable for AM operation; however, a greater battery drain is experienced because the Vipac is on continuously. In the second method the Vipac plug remains connected and the "S" meter plug on the Receiver is utilized. The jumper between pins 6 (ground) and 5 of the "S" meter plug is then connected to the push-to-talk relay. Whenever the circuit between pins 5 and 6 is open the receiver is instantaneously blanked, even though all other voltage on the tubes remain on and unchanged.

Antenna Input

Since the KE-93 is intended for both mobile and fixed station use, a nominal input impedance of 50 ohms was chosen for all bands, excepting Broadcast Band which is the usual high impedance input necessary for flat receiver sensitivity over the entire band



CONDENSER VALUES

C1	3-12 PF.	(O)
C2	3-12 PF.	(O)
C3	5-25 PF.	(O)
C4	750 PF.	(S)
C5	12 PF. 5%	(S)
C6	5-25 PF.	(O)
C7	5-25 PF.	(O)
C8	31 PF.	(S)
C9	3-12 PF.	(O)
C10	43 PF.	(N)
C11	1800 PF.	(S)
C12	5-25 PF.	(O)
C13	3-12 PF.	(O)
C14	20 PF.	(N)
C15	5-25 PF.	(O)
C16	5-25 PF.	(O)
C17	91 PF.	(S)
C18	36 PF.	(N)
C19	5-25 PF.	(O)
C20	5-25 PF.	(O)
C21	5-25 PF.	(O)
C22	120 PF.	(S)
C23	3-12 PF.	(O)
C24	15 PF.	(N)
C25	5-25 PF.	(O)
C26	5-25 PF.	(O)
C27	200 PF.	(S)
C28	36 PF.	(N)
C29	5-25 PF.	(O)
C30	5-25 PF.	(O)
C31	5-25 PF.	(O)
C32	30 PF.	(S)
C33	15 PF.	(N)
C34	3-12 PF.	(O)
C35	10 PF.	(S)

CODE

O = NEGATIVE, POSITIVE-ZERO.
S = SILVER MICA.
N = NEGATIVE TEMPERATURE COEFFICIENT. (N750)

FREQUENCY COVERAGE

BAND 1	550-1650 KC.
BAND 2	1650-3500 KC.
BAND 3	3500-4030 KC.
BAND 4	6990-7310 KC.
BAND 5	13970-14360 KC.
BAND 6	20990-21450 KC.
BAND 7	27950-30000 KC.

NOTE:
INDIVIDUAL SETS MAY HAVE SLIGHTLY DIFFERENT VALUE CONDENSERS INSTALLED AT THE FACTORY. ALL CONDENSERS ±2% UNLESS OTHERWISE SPECIFIED.
ALL COMPONENTS ARE 300 SERIES.

Figure 12. Turret assembly, schematic

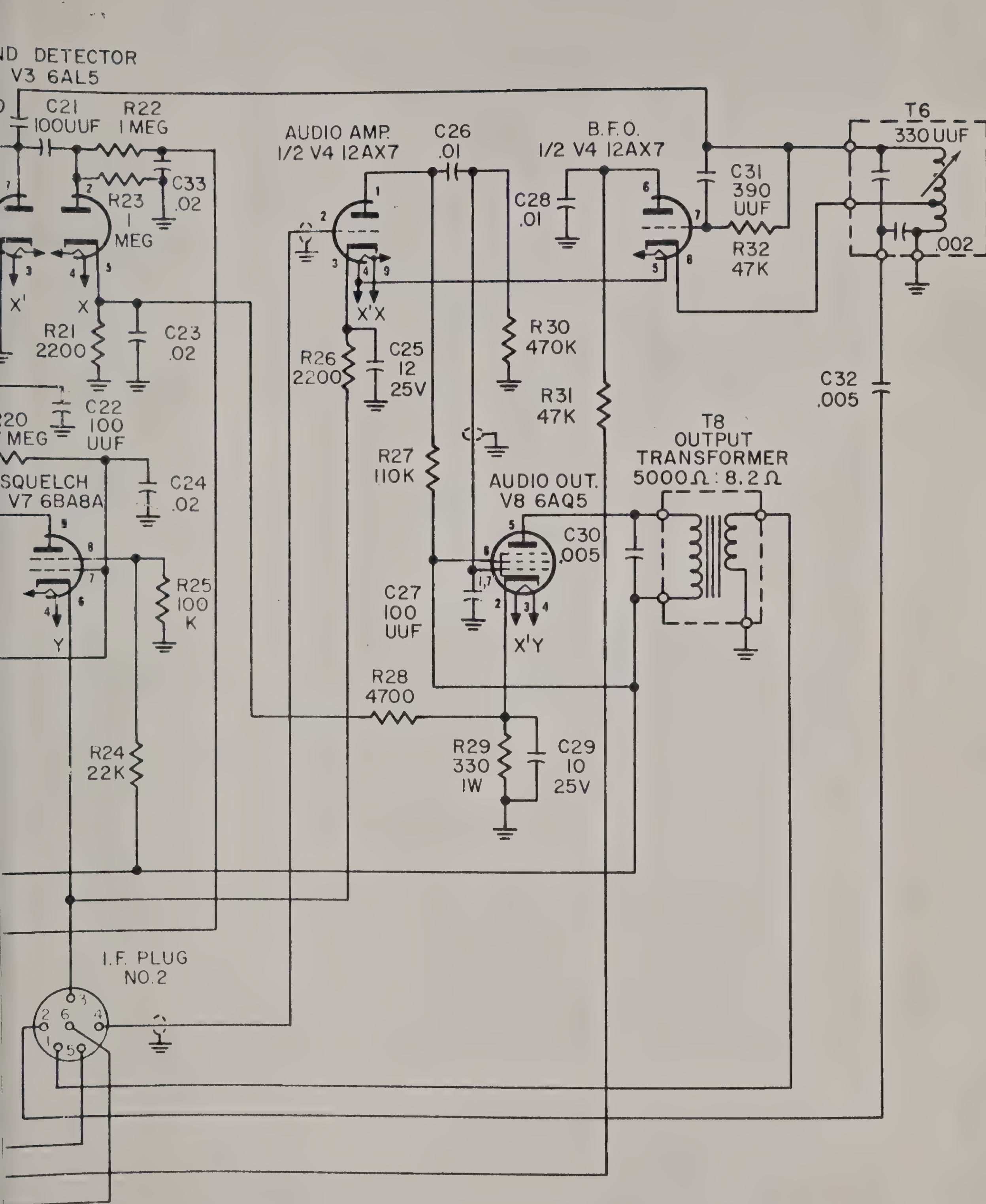
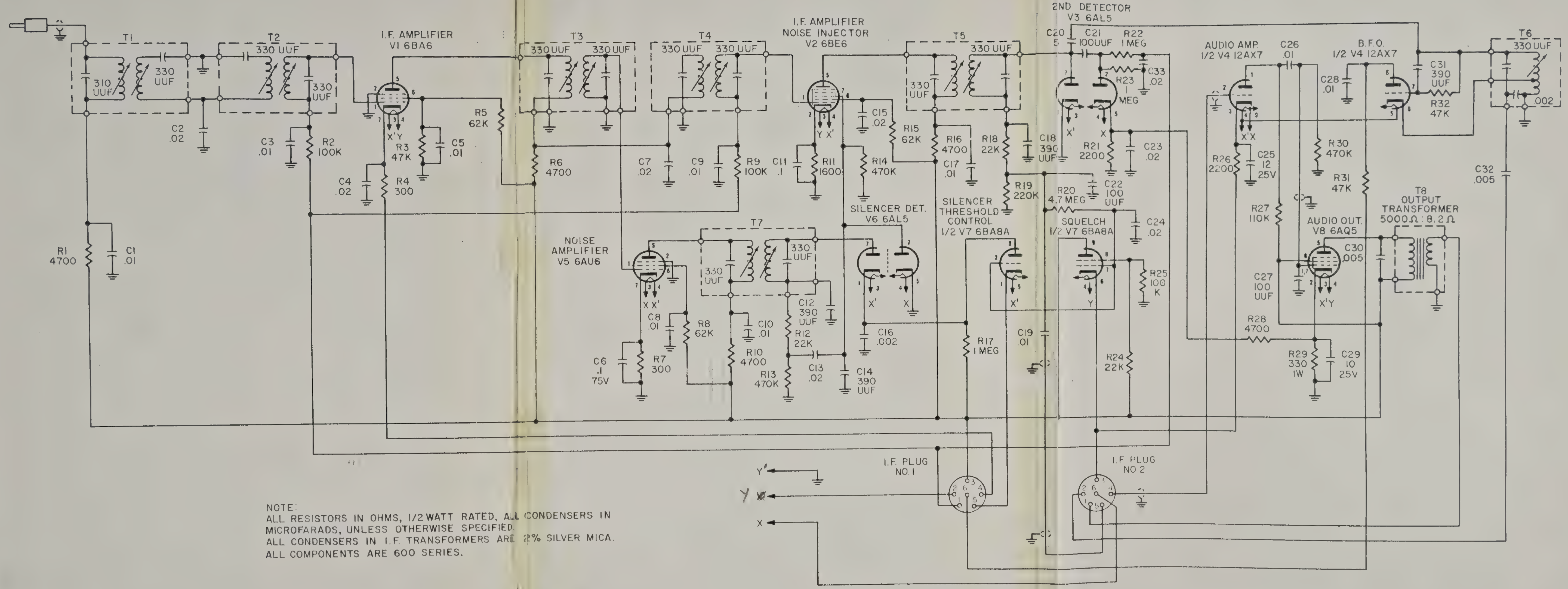
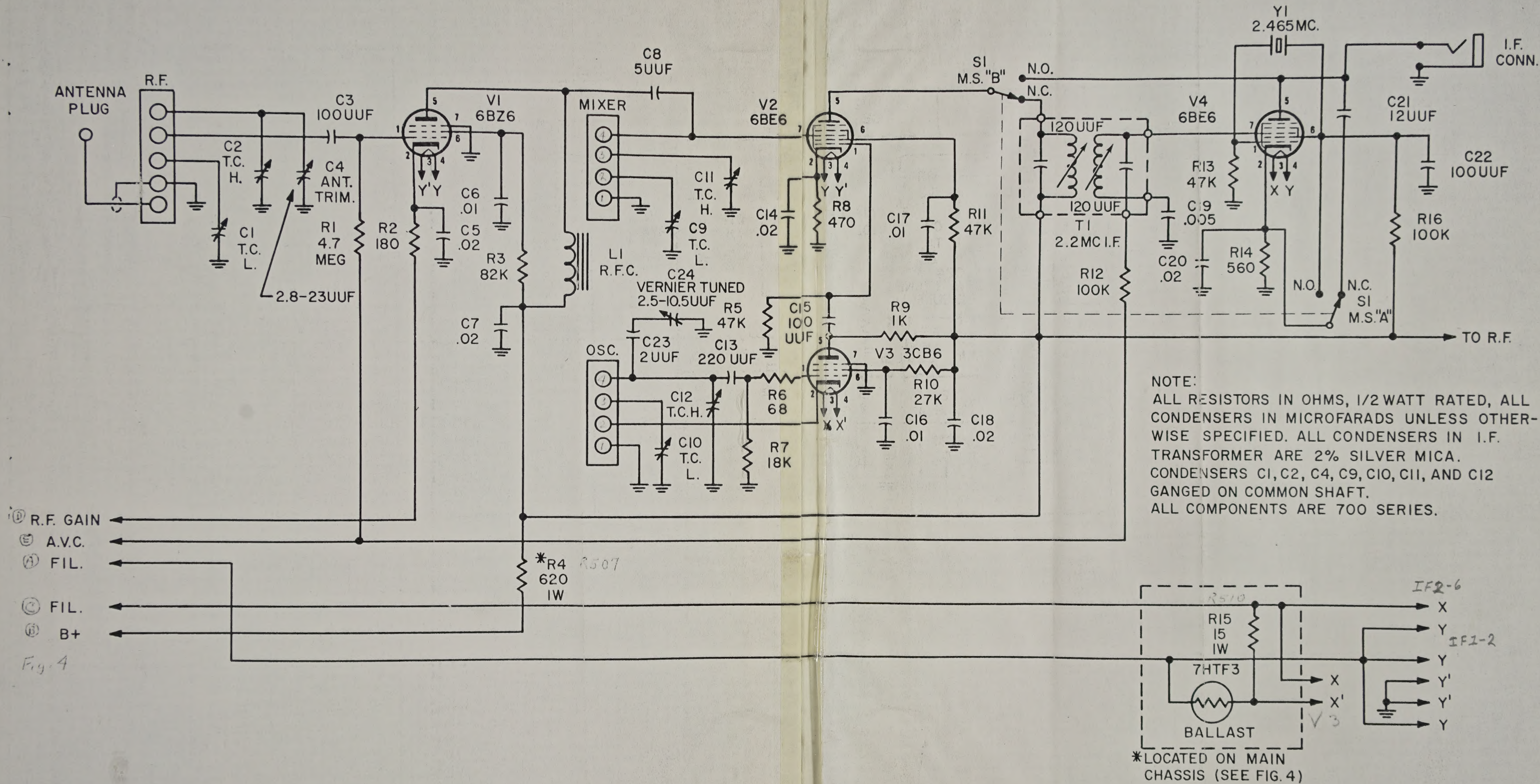


Figure 15. IF Chassis, schematic



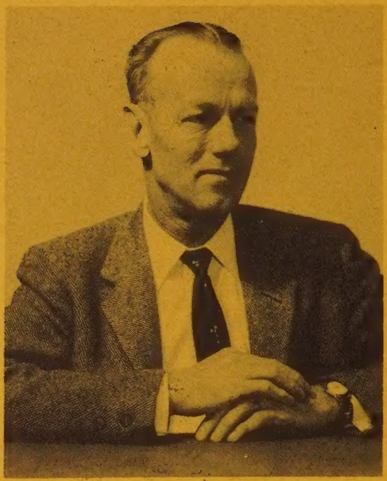
NOTE:
ALL RESISTORS IN OHMS, 1/2 WATT RATED, ALL CONDENSERS IN MICROFARADS, UNLESS OTHERWISE SPECIFIED.
ALL CONDENSERS IN I.F. TRANSFORMERS ARE 2% SILVER MICA.
ALL COMPONENTS ARE 600 SERIES.

Figure 15. IF Chassis, schematic



NOTE:
ALL RESISTORS IN OHMS, 1/2 WATT RATED, ALL CONDENSERS IN MICROFARADS UNLESS OTHERWISE SPECIFIED. ALL CONDENSERS IN I.F. TRANSFORMER ARE 2% SILVER MICA. CONDENSERS C1, C2, C4, C9, C10, C11, AND C12 GANGED ON COMMON SHAFT. ALL COMPONENTS ARE 700 SERIES.

Fig. 4



KARL E. PIERSON, B.S.E.E., M.SC., E.E.E. (HON)

W6BGH

CHIEF ENGINEER, AUTOMATION ELECTRONICS, INC.

Karl Pierson is the designer of the KE-93 and many other famous receivers, such as the PR-15, PR-16, and KP-81. He has been an avid amateur radio fan since 1921, and has been engaged in the design of radio receivers and communication equipment for over 25 years. During these years, he has been the recipient of many public service and other outstanding awards in recognition of his contribution to amateur radio.

Mr. Pierson is a Senior Member of the Institute of Radio Engineers and a Member of the Armed Forces Communications and Electronics Association. He is a Registered Professional Engineer in the State of California.

AUTOMATION ELECTRONICS, INC.

Printed in U.S.A.